

ENVIRONMENTAL ASSESSMENT

for the

Granting of U.S. Navy Easements

Near Pearl Harbor and Waikele Gulch
Oahu, Hawaii

to

HAWAIIAN ELECTRIC COMPANY, INC.

for the

Waiau-Campbell Industrial Park
138-kV Transmission Line, Part 2, Project



19950407 114

DTIC QUALITY INSPECTED 5

September 23, 1994

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
<p>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</p>			
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED	
	* 23 Sep 1994	Final	
4. TITLE AND SUBTITLE * Environmental Assessment for the granting of U.S. Navy easements near Pearl Harbor and Waikale Gulch Oahu, Hawaii to Hawaiian Electric Company, Inc.		5. FUNDING NUMBERS	
6. AUTHOR(S) Luerssen, P. Kanehiro, C. Wiley, M. Soloway, M. Hart, J.			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) * Hawaiian Electric Company, Inc. Honolulu, Hawaii		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Navy Pacific Division, Naval Facilities Engineering Command Pearl Harbor, Hawaii		10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION/AVAILABILITY STATEMENT * Public Release		12b. DISTRIBUTION CODE A	
13. ABSTRACT (Maximum 200 words) This document was prepared pursuant to the National Environmental Policy Act (NEPA) and Navy regulations (OPNAVINST 5090.1B). The document addresses environmental impacts from the proposed granting of three easements to the Hawaiian Electric Company, Inc. (HECO) for the use of Navy property near Waikale Gulch, Pearl City Peninsula and the Waiau Power Plant. HECO's proposed Waiau-CIP, Part 2, Project requires installation, operation, and maintenance of steel transmission line poles and associated equipment on three Navy parcels crossed by the 7.8 mile project. Health risks from exposure to the electric and magnetic fields of 138-kV transmission lines are discussed.			
DTIC QUALITY INSPECTED 5			
14. SUBJECT TERMS Electric and magnetic fields.		15. NUMBER OF PAGES 163	16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT

Environmental Assessment for the Granting of U.S. Navy Easements to Hawaiian Electric Company, Inc. for the Waiau-Campbell Industrial Park 138-kV Transmission Line, Part 2, Project Near Pearl Harbor

Lead

Agency: U.S. Navy

Coordinating

Agency: Pacific Division
Naval Facilities Engineering Command
Pearl Harbor, Hawaii

Applicant:

Hawaiian Electric Company, Inc. (HECO)
Honolulu, Hawaii

Prepared by:

CH2M HILL
1585 Kapiolani Boulevard, Suite 1420
Honolulu, Hawaii 96814

Contact:

Mr. Stanley Uehara, Code 232
Environmental Planning Division
Pacific Division, Naval Facilities Engineering Command
Pearl Harbor, Hawaii 96860-7300
Telephone (808) 471-9338

Abstract:

The U.S. Navy proposes to grant easements to Hawaiian Electric Company, Inc., to install, operate, and maintain steel transmission line poles, conductors, and/or guy poles, wires, and anchors along three specific areas of the proposed alignment for the Waiau-Campbell Industrial Park (CIP) 138-kV Transmission Line, Part 2, Project. Navy easements are required inland of the H-1 freeway in the vicinity of Waikiki Gulch, on the Pearl City Peninsula adjacent to the existing bike path and energy corridor, and near the Waiau Power Plant makai of the H-1 freeway. The proposed action is required because the areas subject to Navy easements are an integral part of the 7.8-mile Waiau-CIP 138-kV Transmission Line, Part 2, Project. The Part 2 Project is the eastern portion of a new system that will interconnect the CIP substation with the Waiau Power Plant. The western portion of the system is called the Waiau-CIP Transmission Line, Part 1, Project. Both Part 1 and Part 2 are needed to:

- increase system reliability by establishing an alternate transmission line corridor,
- provide additional transmission capacity in the Ewa and Central Oahu Districts to meet expected load growth, and

Accesion For	
NTIS	CRA&I
DTIC	TAB
Unannounced	
Justification _____	
By _____	
Distribution / _____	
Availability Codes	
Dist	Avail and / or Special
A-1	

- meet transmission requirements for existing and planned power generation projects in the area.

The proposed granting of easements by the Navy to HECO is not anticipated to have any adverse environmental effects which cannot be avoided or resolved through mitigation. Long-term land use impacts to proposed residential development can be avoided by appropriate setbacks of residential areas from the overhead lines. Short-term impacts to the bike path can be mitigated by maintaining continuous public use on paved areas for bicyclists during installation of the poles and conductors. Traffic impacts during construction will be coordinated with the State Department of Transportation and the County Department of Transportation Services. Visual clutter will be mitigated through the consolidation of existing lower voltage lines onto the 138-kV poles. No species within the easement areas are listed as, or candidates for, endangered or threatened status. Nonwoody and cultivated wetlands located near the Waiau Power Plant will be avoided during construction of the proposed alignment in that area. During an informal Section 7 consultation, the U.S. Fish and Wildlife Service determined that this project would have no significant adverse impact to the area's fish and wildlife resources.

Although there is no conclusive evidence of significant health risks from exposure to the electric and magnetic fields of 138-kV transmission lines, the public is concerned about this issue. That concern is being addressed through the use of low-reactance phasing, where feasible, to reduce the electric and magnetic field strengths. Pre- and post-construction measurements of electric and magnetic fields will be conducted in consultation with nearby communities.

The Navy has determined that the proposed action is consistent with the State of Hawaii Coastal Zone Management Program goals and objectives. The Hawaii Office of State Planning has concurred with this determination. During prior consultations with the Department of Land and Natural Resources concerning the proposed Waiau-CIP, Part 2 transmission line, the State Historic Preservation Office concurred that overhead lines are likely to have "no effect" upon historic sites, including human burials. Under Section 106 consultations specific to this project, the SHPO determined that this specific project would also have "no effect on historic sites." An archaeologist will be present during excavation to monitor for archaeological resources. Should any unexpected archaeological deposits be discovered during excavations, work will stop and the State Historic Preservation Office will be consulted.

Alternatives to the proposed action considered were no-action (the Navy would not grant HECO's request for easements) and an overhead alignment along the H-1 freeway which would require use of an existing 46-kV easement from the Navy. Alternatives to the proposed Waiau-CIP

transmission line alignment were addressed in a separate State environmental impact statement accepted by the Department of Transportation on 26 August 1992. These alternatives included: an overhead/underground alignment along H-1; and overhead alignment along Farrington Highway; an underground alignment along Farrington Highway; an overhead alignment within Oahu Sugar Lands above the Village Park development; and an overhead/underground alignment along the Oahu Railway & Land (OR&L) right-of-way.

The no-action alternative was eliminated because it would not meet the reliability and capacity criteria established for the overall project. Use of alternatives which would not need a Navy easement in the Waikeli Gulch were eliminated because they were too costly or because they place more residential units in close proximity to the line in the future. The alternative using the existing 46-kV easement from the Navy was eliminated as it would create conflicts with future land uses proposed for the property by the U.S. Navy. The granting of easements within the proposed parcels to HECO by the U.S. Navy represents the most cost-effective alternative with the least impact to the environment available to meet the purpose and need criteria.

The Hawaii Public Utilities Commission approved HECO's request to construct the transmission lines along the alignment proposed by HECO. In its Decision and Order No. 13201 issued April 7, 1994, the Commission's conclusion after considering all the evidence is that, "HECO's selected routing, location, configuration and method of construction for (the proposed transmission lines) are reasonable and preferable to HECO's other options, comparing the following factors: cost; construction time; health effects, including the effect of EMF; safety; aesthetic considerations; depreciation of property values; interference with radio and television reception; and the public welfare in general."

Contents

	<u>Page</u>
Abstract	i
Contents	v
1 Summary and Introduction	1-1
1.1 Identification of Document	1-1
1.2 Title of Action	1-1
1.3 Brief Description of Proposed Action	1-1
1.4 Summary of Adverse Impacts and Mitigation	1-2
1.5 Summary of Alternatives Considered	1-3
1.6 Significance of Impacts	1-4
1.7 List of Agencies Contacted	1-4
2 Purpose and Need	2-1
2.1 Background	2-1
2.2 Purpose and Need	2-3
2.2.1 System Reliability	2-3
2.2.2 Load Growth	2-4
2.2.3 New Power Generation	2-4
3 Alternatives	3-1
3.1 Background	3-1
3.2 Description of the Proposed Action	3-1
3.2.1 Location	3-1
3.2.2 Technical Characteristics	3-4
3.2.3 Construction Practices	3-4
3.2.4 Right-of-Way Acquisition and Use	3-9
3.2.5 Project Schedule, Cost, and Work Force	3-9
3.3 Alternatives Considered	3-10
3.3.1 No-Action Alternative	3-12
3.3.2 46-kV Easement Alternative (H-1 Overhead)	3-12
3.3.3 H-1 Overhead/Underground Alternative	3-12
3.3.4 Farrington Overhead Alternative	3-12
3.3.5 Farrington Underground Alternative	3-13
3.3.6 Oahu Railway & Land Overhead/Underground Alternative	3-13
3.3.7 Uplands Oahu Sugar Lands Overhead	3-13
3.4 Summary	3-14

Contents (Continued)

	<u>Page</u>
4 Existing Environment	4-1
4.1 Land Use	4-1
4.1.1 Waipahu Section	4-1
4.1.2 Pearl City Section	4-2
4.2 Visual Resources	4-8
4.2.1 Waipahu Section	4-9
4.2.2 Pearl City Section	4-9
4.3 Electric and Magnetic Fields	4-10
4.3.1 Transmission Line Voltage Classification	4-10
4.3.2 Electric Fields	4-10
4.3.3 Magnetic Fields	4-11
4.3.4 Electric Field and Magnetic Field Standards	4-14
4.3.5 Other Transmission Line Electrical Factors	4-18
4.4 Biological Resources	4-20
4.4.1 Vegetation	4-20
4.4.2 Wildlife	4-25
4.5 Water Resources	4-26
4.5.1 Surface Waters	4-26
4.5.2 Groundwater	4-26
4.6 Earth Resources	4-26
4.6.1 Geology	4-26
4.6.2 Soils	4-31
4.7 Transportation and Traffic	4-31
4.8 Utilities, Pipelines, and Hazardous Waste	4-32
4.8.1 Electric Utilities	4-32
4.8.2 Oil and Gas Pipelines	4-32
4.8.3 Water, Sewer, and Communication Ductwork	4-37
4.9 Air Quality	4-37
4.10 Noise	4-38
4.11 Cultural and Historic Resources	4-38
4.11.1 National Register Historic District and National Historic Landmark	4-38
4.11.2 Cultural Resources Potential	4-39
4.12 Public Services	4-43
 5 Environmental Consequences and Mitigation	 5-1
5.1 Land Use	5-1
5.1.1 Impacts	5-1
5.1.2 Mitigation	5-2

Contents (Continued)

	<u>Page</u>
5 Environmental Consequences and Mitigation (continued)	
5.2 Visual Resources	5-2
5.2.1 Impacts	5-2
5.2.2 Mitigation	5-7
5.3 Electric and Magnetic Fields	5-7
5.3.1 Electric Field Values for the Proposed Project	5-7
5.3.2 Magnetic Field Levels for the Proposed Project	5-10
5.3.3 EMF Calculation Assumptions	5-10
5.3.4 Health Effects of Electric and Magnetic Fields	5-10
5.3.5 Electric and Magnetic Field Standards	5-25
5.3.6 Other Transmission Line Electrical Factors	5-26
5.3.7 Conclusions	5-28
5.4 Biological Resources	5-28
5.4.1 Impacts	5-28
5.4.2 Mitigation	5-29
5.5 Water Resources	5-29
5.5.1 Impacts	5-29
5.5.2 Mitigation	5-30
5.6 Earth Resources	5-30
5.6.1 Impacts	5-30
5.6.2 Mitigation	5-30
5.7 Transportation and Traffic Impacts	5-31
5.7.1 Impacts	5-31
5.7.2 Mitigation	5-32
5.8 Utilities, Pipelines, and Hazardous Waste Impacts	5-32
5.8.1 Impacts	5-32
5.8.2 Mitigation	5-32
5.9 Air Quality	5-33
5.9.1 Impacts	5-33
5.9.2 Mitigation	5-33
5.10 Noise	5-33
5.10.1 Impacts	5-33
5.10.2 Mitigation	5-36
5.11 Cultural and Historic Resources	5-37
5.11.1 Impacts	5-37
5.11.2 Mitigation	5-37
5.12 Public Services	5-38
5.12.1 Impacts	5-38
5.12.2 Mitigation	5-38

Contents (Continued)

	<u>Page</u>
5.13 Summary	5-38
5.13.1 Irreversible and Irretrievable Commitments of Resources	5-38
5.13.2 The Relationship Between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity ..	5-38
5.13.3 Cumulative Impacts	5-39
5.13.4 Summary of Unresolved Impacts	5-39
5.13.5 Relationship to Federal, State, and County Land Use Plans, Policies, and Controls	5-39
5.13.6 Means of Mitigating Potentially Adverse Effects	5-45
5.13.7 Adverse Environmental Effects Which Cannot be Avoided and Unresolved Issues	5-46
6 List of Preparers	6-1
7 Bibliography	7-1

Appendices

A	U.S. Army Corps of Engineers Consultation
B	U.S. Fish and Wildlife Section 7 Consultation
C	Section 106 Consultation Letter
D	Coastal Zone Management Determination Application

Tables

1-1	List of Recipients of the Draft Environmental Impact Statement	1-6
3-1	Waiau-CIP Part 2 138-kV Transmission Line Design Characteristics	3-6
3-2	Summary of Impacts	3-15
4-1	Typical Electric Field Values for Household Appliances (at 12 inches)	4-11
4-2	Typical Magnetic Field Values for Household Appliances	4-12
4-3	Summary of Everyday Magnetic Field Levels	4-13
4-4	Magnetic Field Levels Pacific Palisades and Pearl City	4-15
4-5	Magnetic Field Levels Village Park	4-16
4-6	State Regulations that Limit Field Strengths on Transmission Line Rights-of-Way	4-17
4-7	Interim Guidelines on Limits of Exposure to 50/60-Hz Electric and Magnetic Fields	4-18
4-8	Peak and 24-Hour Traffic Volumes, H-1 Freeway-1989	4-31
4-9	Historic Sites on File with State of Hawaii	4-40

Contents (Continued)

	<u>Page</u>
Tables (continued)	
5-1 Estimated Magnetic Field Levels for Typical Pole Configurations (Normal Loadings)	5-11
5-2 Estimated Magnetic Field Levels for Typical Pole Configurations (Emergency Loadings)	5-12
5-3 Comparison of Transmission Line Construction Equipment Noise with Other Common Sound Levels	5-35
5-4 Allowable Noise Levels (dBA)	5-36
Figures	
2-1 Study Area Location	2-2
3-1 Project Parcel at Waikeli Gulch Subject to Navy Easement	3-2
3-2 Project Parcel at Waiau Subject to Navy Easement	3-3
3-3 Typical Pole Configurations	3-5
3-4 Alternative Alignments	3-11
4-1 Existing and Proposed Land Use (Map 2)	4-3
4-2 Existing and Proposed Land Use (Map 3)	4-5
4-3 Special Management Area at Pearl City and Waiau Plant Parcels	4-7
4-4 Geophysical and Biological (Map 2)	4-21
4-5 Geophysical and Biological (Map 3)	4-23
4-6 Water Resources	4-27
4-7 Slope	4-29
4-8 Soils	4-33
4-9 Utility and Transportation Systems	4-35
4-10 Cultural Resources	4-41
5-1 From H-1 Near Village Park Looking Inland	5-3
5-2 From Village Park Looking Seaward	5-4
5-3 Locations of Typical Pole Configurations at Waikeli	5-8
5-4 Locations of Typical Pole Configurations at Waiau	5-9
5-5 Lateral Plot of Magnetic Field for Configuration 1	5-13
5-6 Lateral Plot of Magnetic Field for Configuration 2	5-14
5-7 Lateral Plot of Magnetic Field for Configuration 3	5-15
5-8 Lateral Plot of Magnetic Field for Configuration 4	5-16
5-9 Lateral Plot of Magnetic Field for Configuration 5	5-17
5-10 Lateral Plot of Magnetic Field for Configuration 6	5-18

Acronyms and Abbreviations

ac	alternating current
AES-BP	Applied Energy Services—Barbers Point
CFR	Code of Federal Regulations
CZM	Coastal Zone Management
dBA	decibel A-weighted
DLU	Department of Land Utilization (City & County of Honolulu)
DOT	Department of Transportation (State of Hawaii)
EA	environmental assessment
EIS	environmental impact statement
ELF	extremely low frequency
EMF	electric and magnetic fields
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ESQD	Explosive Safety Quantity Distance
FEIS	final environmental impact statement
FONSI	Finding of No Significant Impact
G	Gauss
HECO	Hawaiian Electric Company, Inc.
HRS	Hawaii Revised Statutes
Hz	hertz
IITRI	Illinois Institute of Technology Research Institute
kV	kilovolt
kV/m	kilovolts per meter
mG	milliGauss
MOA	Memorandum of Agreement
MW	Megawatt
NAVMAG	Laulualei Naval Magazine
NEPA	National Environmental Policy Act
NESC	National Electric Safety Code
NMFS	National Marine Fisheries Service
OR&L	Oahu Railway and Land Company
ppb	parts per billion
PUC	Public Utilities Commission (State of Hawaii)
RF	radio frequency
SMA	Special Management Area
USFWS	U.S. Fish and Wildlife Service
V/m	volts per meter

Chapter 1

Summary and Introduction

1.1 Identification of Document

This document is an Environmental Assessment for an administrative action prepared pursuant to the National Environmental Policy Act (NEPA) and Navy regulations (OPNAVINST 5090.1A).

1.2 Title of Action

Granting of U.S. Navy Easements to Hawaiian Electric Company, Inc. for the Waiau-Campbell Industrial Park 138-kV Transmission Line, Part 2, Project near Pearl Harbor, Oahu, Hawaii.

1.3 Brief Description of Proposed Action

The U.S. Navy proposes to grant three easements for the use of Navy property to the Hawaiian Electric Company, Inc. (HECO). The parcels are identified as:

- 1) **Waikele Gulch Area:** Portion of land parcel identified as TMK 9-4-02:12 for an overhead crossing of the Navy access road just north of the H-1 Freeway right-of-way. The proposed aerial easement would allow conductors from the 138-kilovolt (kV) double-circuit transmission line system to pass over the road with adequate clearance.
- 2) **Pearl City Peninsula Area:** Portion of land parcel identified as TMK 9-7-18:03 for an overhead 138-kV single-circuit transmission line system with a 46-kV underbuild. The proposed 50-foot-wide easement would consist of the 40-foot-wide bike path area for construction, installation, operation, maintenance, repair and replacement purposes and a 10-foot-wide strip of land immediately adjacent thereto in TMK 9-7-18:20 and the energy corridor portion in TMK 9-7-18:03 for overhang and line sway purposes. An easement for TMK 9-7-18:10, which lies under the H-1 Freeway, will be necessary to accommodate the line's crossing of the freeway.
- 3) **Waiau Power Plant Site:** Portion of land parcel identified as TMK 9-8-03:33 for an overhead crossing of a 138-kV single-circuit transmission line system and portion of land parcel identified as TMK 9-8-04:16 for an overhead crossing of a 138-kV double-circuit transmission line system. The proposed aerial easements would provide for an overhead connection of the lines from HECO-owned properties on both sides of the easement areas.

Also, HECO has requested permission to route the 138-kV system through restrictive use easements held by the Navy within the Amfac/JMB Waikeli Business Park. These easements parallel the H-1 Freeway right-of-way in the vicinity of the Paiwa Interchange. Utilities and overhead lighting are permitted improvements under the terms and conditions of these restrictive use easements. However, the proposed easements for the 138-kV system would be granted to HECO by the current land owner, Amfac/JMB Hawaii, Inc.

Easements are needed by HECO for the installation, operation, and maintenance of transmission line poles, conductors, guy poles, wires, and anchors along the preferred alignment of the 7.8-mile Waiau-Campbell Industrial Park (CIP) 138-kV Transmission Line, Part 2, Project. The Part 2 Project is the eastern portion of a new system that will interconnect the CIP substation with the Waiau Power Plant. The western portion of the system is called the Waiau-CIP Transmission Line, Part 1, Project. Both Part 1 and Part 2 are needed to meet transmission requirements for new power generation projects located in Campbell Industrial Park and to improve islandwide transmission system reliability. The proposed action to grant easements to HECO is required because the areas subject to Navy easements are integral parts of the overall Waiau-CIP, Part 2, Project. The overall Waiau-CIP project is needed for the following reasons:

- To increase system reliability by establishing an alternate transmission line corridor, as recommended in 1984 (Stone and Webster, 1984).
- To provide additional transmission capacity in the Ewa and Central Districts of Oahu to meet expected load growth.
- To meet transmission requirements for existing and planned power generation projects in the Campbell Industrial Park area.

1.4 Summary of Adverse Impacts and Mitigation

A Routing Report (February 1992) and a Final Environmental Impact Statement (State Final EIS, August 1992) were prepared for the Waiau-CIP, Part 2, Project. The State Final EIS was submitted to the State of Hawaii Department of Transportation (DOT), pursuant to Chapter 343, Hawaii Revised Statutes (HRS), relating to environmental review. The Routing Report and the State Final EIS addressed the potential impacts associated with the use of freeway and highway rights-of-way for the Waiau-CIP, Part 2, Project. The overall 7.8-mile Waiau-CIP, Part 2, Project begins at the new Ewa Nui Substation in Ewa and terminates at the Waiau Power Plant in Pearl City.

HECO's proposed Waiau-CIP, Part 2, Project involves installation, operation, and maintenance of steel transmission line poles and associated equipment (poles, conductors, guy wires, and anchors) on Navy property or in existing Navy easements within the proposed project area. Analyses of the environmental impacts of the proposed granting of Navy easements are based on the information contained in the Routing Report and the State Final EIS for the Waiau-CIP,

Part 2, Project. The Hawaii DOT issued a determination of acceptance of the State Final EIS on 26 August, 1992, pursuant to Chapter 343, HRS.

The proposed granting of easements by the Navy to HECO is not anticipated to have any adverse environmental effects which cannot be avoided or resolved through mitigation. Long-term land use impacts to proposed residential development can be avoided by appropriate setbacks of residential areas from the overhead lines. Short-term impacts to the bike path can be mitigated by maintaining paved areas for bicyclists to use during installation of the poles and conductors. Traffic impacts during construction will be coordinated with the State Department of Transportation. Visual clutter will be mitigated through consolidation of existing lower voltage lines onto the 138-kV poles. No species within the easement areas are listed as, or are candidates for, endangered or threatened status. An archaeologist will be present during all excavation to monitor for archaeological resources. Should any unexpected archaeological deposits be discovered during excavations, work will stop and the State Historic Preservation Office will be consulted.

1.5 Summary of Alternatives Considered

The alternatives to the proposed action include no action (denial of request to grant easements to HECO) and an alternative alignment that uses an existing 46-kV easement on Navy property near the Waiau Power Plant.

Under the no-action alternative, it is assumed that the overall project would not be constructed. Therefore, Part 1 would not be connected to Part 2 of the system, transmission requirements for new power generation projects located in the CIP area would not be met, and islandwide transmission system reliability would be compromised.

The 46-kV easement alternative is similar to the proposed alignment except for one area, it would follow an existing 46-kV easement on Navy property near the Waiau Power Plant and cross over wetlands instead of following the bike path. This route was the original preferred alignment presented in the Routing Report and the State Final EIS for the Waiau-CIP, Part 2, Project. However, this alternative would limit Navy development potential for the affected parcel. Because of this potential land use conflict, the Navy requested HECO to follow the bike path and this alternative was not evaluated further.

Other alternative alignments for the Waiau-CIP transmission line are briefly described in this document and are fully evaluated in the Routing Report and the State Final EIS for the Waiau-CIP, Part 2, Project. They have been eliminated from detailed environmental review in this document because they have greater environmental impacts and higher construction costs than the two build alternatives evaluated in this EA. In addition, they are not preferred by the community and affected landowners, including the Navy. In its decision to approve the project, the Hawaii Public Utilities Commission agreed that the proposed action and route are preferable to other alternatives after considering a variety of environmental and engineering factors. The other alternatives include:

- H-1 Overhead/Underground
- Farrington Overhead
- Farrington Overhead/Underground
- Oahu Railway & Land (OR&L) Overhead/Underground
- Upland Oahu Sugar Lands Overhead

1.6 Significance of Impacts

No significant adverse effects resulting from the granting of Navy easements to HECO have been identified. During project construction, traffic will be disrupted, there may be increased exhaust emissions and particulate levels, and there will be increased noise in some locations. However, these impacts will be short term, lasting no longer than 2 to 4 months. Although there is no conclusive evidence of significant health risks from exposure to the electric and magnetic fields of 138-kV transmission lines, the public is concerned about this issue. That concern is being addressed through the use of low-reactance phasing, where feasible, to reduce the electric and magnetic field strengths. Pre- and post-construction measurements of electric magnetic fields will be conducted in consultation with nearby communities.

1.7 List of Agencies Contacted

Table 1-1 lists the recipients of the State Draft Environmental Impact Statement (DEIS) for the Waiau-CIP, Part 2, Project, and notes which parties commented on the document. The table reflects consultation activities that took place between April 1992 and June 1992. The State Final EIS, on which this environmental assessment is based, incorporated the comments received during the consultation period. Further consultation occurred after June 1992 in the preparation of this document with members of the Navy, Hawaii Office of State Planning, Amfac/JMB, Village Park Community Association, and Waikiki Commercial Center Associates.

In addition, extensive public involvement activities were conducted between 1987 and 1991 during the preparation of the Routing Report (1992) for the Waiau-CIP, Part 2, Project. These activities included neighborhood board and community association informational meetings, consolidated application process meetings, and public workshops. Questions, concerns, and comments from individuals, agencies, and elected officials were incorporated into the route selection process and thoroughly addressed in both the Routing Report and the State Final EIS. A detailed account of these public involvement activities can be found in Chapter 8 of the State Final EIS.

Agencies contacted during the preparation of this Federal environmental assessment included:

Federal Government

- Department of the Army
 - U.S. Army Corps of Engineers
- Department of the Interior
 - U.S. Fish and Wildlife Service

State of Hawaii

- Office of State Planning
- Department of Land and Natural Resources

**Table 1-1 List of Recipients of the
Draft Environmental Impact Statement**

Page 1 of 3

	Response
Federal	
Army Directorate of Facilities Engineer	NR
Regional Division U.S. Environmental Protection Agency	NR
Environmental Protection Agency-PAC Islands Contact	NR
Department of the Navy, Naval Base, Pearl Harbor	R
Mr. J. M. Kilian, Director	
Real Estate Division	
Dept. of Navy, Pacific Div.	
Navy Facilities, Engr. Command	
USDA Soil Conservation Service	NC
U.S. Army Corps of Engineers	NR
U.S. Coast Guard	NR
U.S. Fish and Wildlife Service	NR
U.S. Geological Survey	NR
Elected Federal Legislator	
Office of Representative Patsy T. Mink	R
State	
Office of Environmental Quality Control	NC
Department of Agriculture	NR
Department of Accounting and General Services	NC
Department of Defense	R
Department of Education	R
Department of Hawaiian Home Lands	NR
Department of Health	R
Department of Land and Natural Resources (DLNR)	R
DLNR State Historic Preservation Office	NR
Department of Business, Economic Development and Tourism (DBEDT), Land Use Commission	R
DBEDT Library	NR
Housing Finance and Development Corporation	R
Department of Transportation	NR
State Archives	NR
DBEDT State Energy Office	NR
Office of State Planning	R
University of Hawaii	
Environmental Center	R
Marine Programs	NR
Water Resources Research Center	NR
Elected State Legislator	
The Honorable Eloise Tungpalan, State Senate	NR
Key:	R—Response received on DEIS NC—Response received on DEIS, but no comment NR—No response received on DEIS DGP—Agency's comment included in a consolidated response by the Department of General Planning

**Table 1-1 List of Recipients of the
Draft Environmental Impact Statement**

Page 2 of 3

	Response
City and County of Honolulu	
Board of Water Supply	DGP
Building Department	NC, DGP
Department of Housing and Community Development	DGP
Department of General Planning	R
Department of Land Utilization	DGP
Department of Parks and Recreation	NC, DGP
Department of Public Works	DGP
Department of Transportation Services	NC, DGP
Fire Department	DGP
Mr. Jeremy Harris, Managing Director, Municipal Reference and Records Center	NR
Police Department	DGP
Elected City and County of Honolulu Legislators	
The Honorable Arnold Morgado, Jr.	
Chair, City Council	R
The Honorable Rene Mansho	
Council member, City Council	NR
The Honorable John Desoto	
Council member, City Council	NR
City and County of Honolulu Neighborhood Boards	
Mr. Thomas Kam, Chair	
Pearl City Neighborhood Board	NR
Mr. Calvin Kawamoto, Chair	
Waipahu Neighborhood Board	NR
Mr. Michael Wong, Chair	
Ewa Neighborhood Board	NR
Nongovernmental	
American Lung Association	NR
Hawaiian Electric Company	NR
Office of Hawaiian Affairs	NR
Mr. Sam Kaina, Village Park Community Association	NR
Mr. Chris Kanazawa, VP/General Manager	
AMFAC/JMB, Oahu Development Division	R
Mr. Henry Eng (response by Mr. Charles Ehrhorn)	
James Campbell Estate	R
Mr. Richard W. Gushman, II, President	
WCC Associates (Waikiki Center)	R
Key:	
R—Response received on DEIS	
NC—Response received on DEIS, but no comment	
NR—No response received on DEIS	
DGP—Agency's comment included in a consolidated response by the Department of General Planning	

**Table 1-1 List of Recipients of the
Draft Environmental Impact Statement**

Page 3 of 3

	Response
Nongovernmental (continued)	
Mr. Jim Wriston, Oahu Sugar Company, Limited	NR
Mr. Paul Cathcart, Manager Bishop Estate—Land Division	NR
Mr. Steve Mau, Esq., Robinson Estate	NR
Ms. Patrice Lin, Gentry Hawaii Ltd.	NR
Ms. Christine Camp, Project Manager Castle and Cooke Residential, Inc.	NR
Mr. James K. Schuler, President JPS Hawaii, Inc.	NR
News Media	
Honolulu Star Bulletin	NR
Honolulu Advertiser	NR
Sun Press	NR
Key:	R—Response received on DEIS NC—Response received on DEIS, but no comment NR—No response received on DEIS DGP—Agency's comment included in a consolidated response by the Department of General Planning

Chapter 2

Purpose and Need

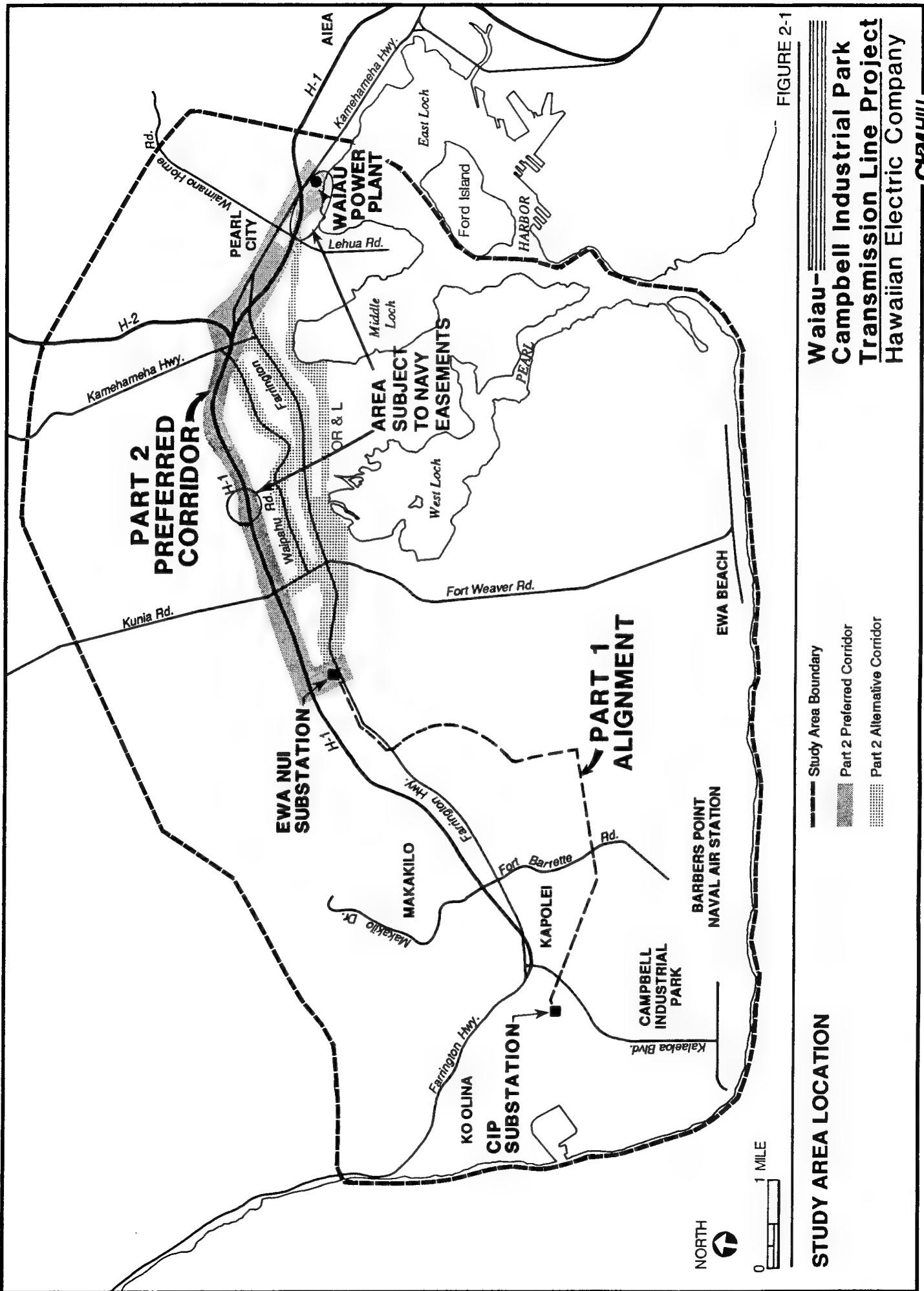
2.1 Background

The Waiau-Campbell Industrial Park (CIP) 138-kilovolt (kV) Transmission Line, Part 2, Project is proposed by Hawaiian Electric Company, Inc. (HECO) as double-circuit, 138-kV alternating current (ac) transmission lines between the new Ewa Nui Substation in Ewa and the Waiau Power Plant, a distance of approximately 7.8 miles (Figure 2-1).

The proposed transmission lines are the eastern portion of a new 138-kV transmission line system that will interconnect the CIP Substation with the Waiau Power Plant. The western portion of the system is called the Waiau-CIP 138-kV Transmission Line, Part 1, Project. This project would connect the CIP Substation with the proposed Ewa Nui Substation. Separate environmental review has been conducted for Part 1 of the project. A routing report (October 1991) and a State Environmental Assessment (August 1992) were prepared for the Waiau-CIP, Part 1, Project. The State Environmental Assessment was submitted to the Hawaii Department of Land and Natural Resources pursuant to Chapter 343, Hawaii Revised Statutes (HRS), and a negative declaration of impacts was granted on January 27, 1993. An application to the State of Hawaii Public Utilities Commission (PUC) for approval of the Part 1 route was filed on October 25, 1991. PUC approval for this application was granted on January 19, 1994.

A Routing Report (February 1992) and a State of Hawaii Final Environmental Impact Statement (Final EIS) were prepared for the Waiau-CIP 138-kV Transmission Line, Part 2, Project (August 1992). The State Final EIS was submitted to the Hawaii Department of Transportation (DOT), pursuant to HRS Chapter 343. The Routing Report and the State Final EIS addressed the potential impacts associated with the use of state highway rights-of-way for construction of the 7.8-mile Waiau-CIP, Part 2, Project. The Hawaii DOT issued a determination of acceptance of the Final EIS on August 26, 1992. An application to the PUC for approval of the Part 2 route was filed on March 12, 1992. PUC approval for this application was granted on April 7, 1994.

This environmental assessment, prepared pursuant to the National Environmental Policy Act (NEPA) and Navy regulations (OPNAVINST 5090.1A), is required to fulfill the U.S. Navy's obligation to review potential environmental impacts of its decision to grant easements to HECO for installation, operation, and maintenance of transmission poles and associated equipment on Navy property or within existing Navy easements, for the Waiau-CIP, Part 2, Project. The portion of HECO's proposed Waiau-CIP, Part 2, Project that is subject to Navy easements involves areas near Waikale Gulch, Pearl City Peninsula, and the Waiau Power Plant.



STUDY AREA LOCATION

Study Area Boundary

Part 2 Preferred Corridor

Part 2 Alternative Corridor

**Waiau—
Campbell Industrial Park
Transmission Line Project
Hawaiian Electric Company**

-CH₂MH₃—

2.2 Purpose and Need

Both Part 1 and Part 2 transmission line projects are needed to meet transmission requirements for new power generation projects located in the CIP area and to improve islandwide transmission system reliability. The sections of the overall Waiau-CIP, Part 2 Project subject to Navy easements are interdependent, and none can be constructed separately. The purpose of and need for the overall Part 2 Project apply equally to all sections (those requiring and those not requiring Navy easements) of the proposed 7.8-mile transmission line project. Therefore, the purpose and need for the proposed action are described in the context of the overall Waiau-CIP, Part 2 Project.

The Waiau-CIP Transmission Line, Part 2, Project is needed for three reasons:

- To increase system reliability by establishing an alternate transmission line corridor, as recommended in 1984 (Stone & Webster, 1984).
- To provide additional transmission capacity in the Ewa and Central Districts of Oahu to meet expected load growth.
- To meet transmission requirements for existing and planned power generation projects in the CIP area.

Each of these reasons is discussed in more detail below.

2.2.1 System Reliability

HECO provides nearly all the electricity for a population of 817,000 on the Island of Oahu. It maintains service to approximately 250,000 metered accounts through its generation, transmission, and distribution systems. The system peak load as of January 1993 was 1,190 megawatts (MW).

Historically, HECO has provided a high level of reliable electric service, and until the early 1980s Oahu had not had a complete electrical blackout for 40 years. In 1982, Hurricane Iwa caused considerable damage to HECO's system, including damage to two of the four 138-kV circuits in the common transmission corridor between the Kahe and Waiau Power Plants. On July 13, 1983, one of these circuits plus another major 138-kV line were out of service for repairs. On that date, a phase-to-phase fault occurred on the Kahe-CIP 138-kV transmission line, which eventually caused circuit breakers to remove the line from the grid. With two 138-kV lines already out of service for repair, the short circuit on the Kahe-CIP line caused severe system instability, leading to automatic shutdown of the generation units and an islandwide blackout.

On September 10, 1988, approximately two-thirds of Oahu incurred an outage. The circumstances surrounding this event were similar to those of the 1983 outage. While two 138-kV circuits (one from Kahe) were out of service to replace two wooden structures with

stronger steel structures, a conductor failure on the CIP-Kahe-Waiau 138-kV circuit caused it to go out of service. The Kahe-Halawa No. 1 138-kV circuit then became overloaded, which left only one of the four circuits leading from the Kahe Power Plant in service. An automatic shutdown of most of the island's generating units occurred, resulting in a blackout that lasted up to 7 hours in some locations.

On April 9, 1991, an islandwide power outage occurred. While one Kahe transmission line was down for maintenance, two other lines, Kahe-Halawa No. 1 and Kahe-Wahiawa, went out of service within 10 minutes of each other. A fourth line exporting power from the Kahe Power Plant shut down to prevent damage to itself. An automatic shutdown of the island's generating units occurred. Findings on the causes of the power outage are inconclusive, and the incident is still under investigation.

After the 1983 blackout, Stone and Webster (1984) undertook a comprehensive investigation of the system. One of the recommendations of this investigation was for HECO to develop a physically separate power transmission corridor from Kahe to the Waiau Power Plant. Such a corridor would reduce the possibility of multiple line outages resulting from a single catastrophe, such as a windstorm or fire. This second transmission corridor, which would be established with the addition of the new Waiau-CIP 138-kV lines, would provide an alternate path along which power could flow if the existing multiple lines from Kahe were lost. This arrangement would improve the reliability of the entire transmission system and would have prevented the systemwide outage of April 9, 1991.

2.2.2 Load Growth

HECO's Forecast Planning Committee updates its forecasts of future loads semiannually. Factors considered in the load forecasts include historical data on loads and population growth, projected future development, increases in population, and associated commercial development. Between 1981 and 1985, peak system loads were relatively level, averaging 935 MW. From 1986 through 1992, peak system loads in the HECO system increased an average of 3.2 percent each year. Future loads are expected to continue to increase at this same rate. The 1994 forecast system peak load is 1,235 MW.

Over the next 20 years, HECO expects that a significant part of the island's load growth will occur in southwest and central Oahu. This is because numerous major residential, commercial, industrial, and recreational developments are planned for the central Oahu and Ewa Plain area.

2.2.3 New Power Generation

New generation resources are required because of the growth in demand for electricity. Since September 1987, when HECO withdrew its application with the Hawaii Public Utilities Commission for the construction of a new 146-MW generating unit at the Kahe Power Plant, HECO has agreed to purchase power from independent power producers in Campbell Industrial Park. Three of the independent power plants are in operation:

- Honolulu Resource Recovery Venture—a 60-MW refuse/waste recovery power plant
- Kalaeloa Partners Limited Partnership—a 185-MW, combined-cycle plant consisting of two oil-fired combustion turbines and one steam turbine
- Applied Energy Services-Barbers Point (AES-BP)—a 180-MW coal-burning plant

HECO's Integrated Resources Plan calls for the addition of more generating units through 1999. Also, a new fluidized bed coal generation system is planned for approximately 2005. The new generation sources will improve HECO's system reliability by contributing to geographical dispersion of power sources and by diversifying generation types. However, Parts 1 and 2 of the Waiau-CIP line are needed to transmit the power to the load centers throughout the island.

Chapter 3 Alternatives

3.1 Background

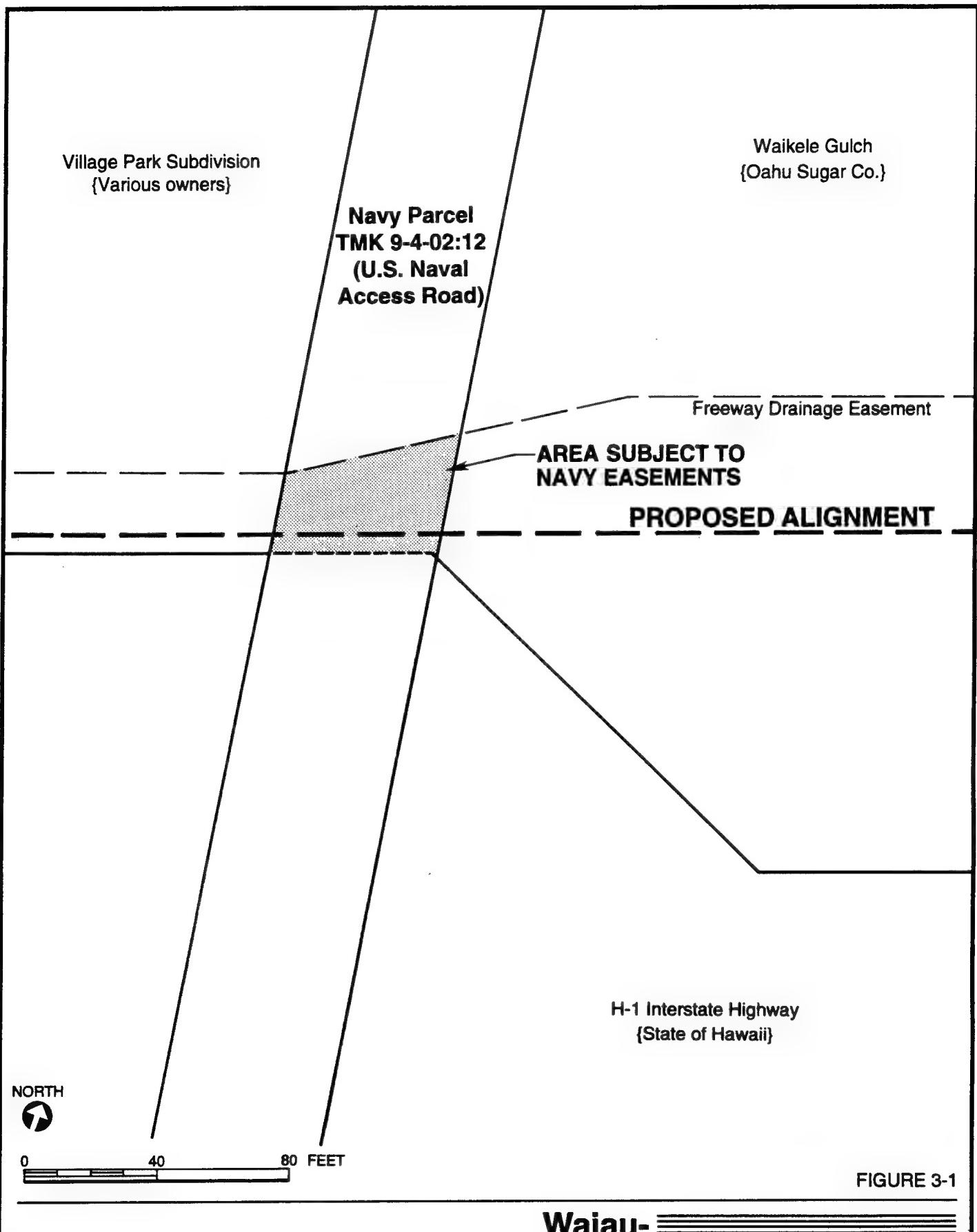
HECO proposes to install, operate, and maintain 138-kV alternating current transmission lines spanning a distance of approximately 7.8 miles to connect the new Ewa Nui Substation in Ewa to the Waiau Power Plant in Pearl City. For the most part, the preferred alignment for the overall project is located within State of Hawaii Department of Transportation rights-of-way.

3.2 Description of the Proposed Action

3.2.1 Location

The U.S. Navy proposes to grant three easements for the use of Navy property to the Hawaiian Electric Company, Inc. The parcels (shown in Figures 3-1 and 3-2) are identified as:

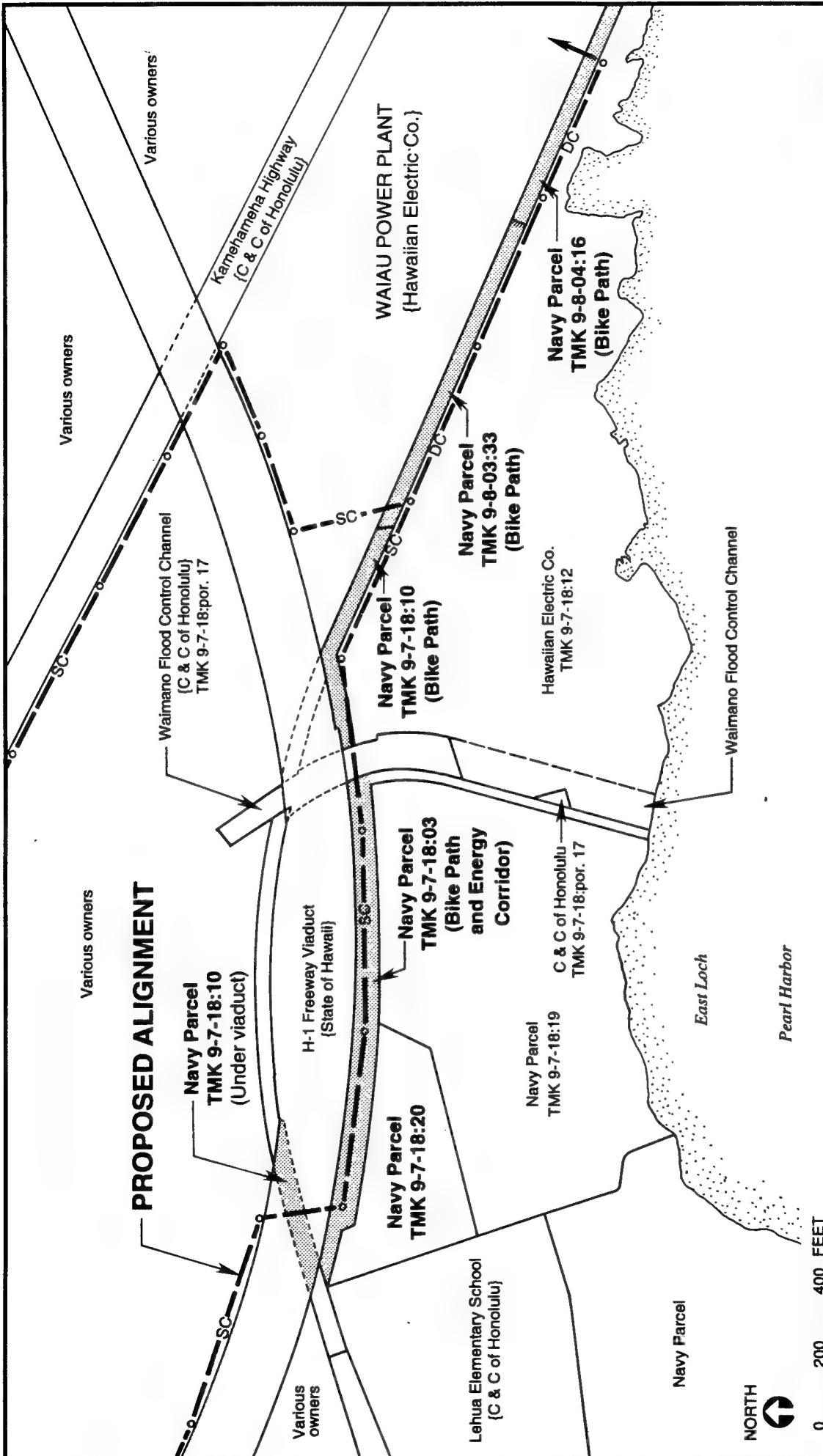
- 1) **Waikele Gulch Area:** Portion of land parcel identified as TMK 9-4-02:12 for an overhead crossing of the Navy access road just north of the H-1 Freeway right-of-way. The proposed aerial easement would allow conductors from the 138-kV double-circuit transmission line system to pass over the road with adequate clearance.
- 2) **Pearl City Peninsula Area:** Portion of land parcel identified as TMK 9-7-18:03 for an overhead 138-kV single-circuit transmission line system with a 46-kV underbuild. The proposed 50-foot-wide easement would consist of the 40-foot-wide bike path area for construction, installation, operation, maintenance, repair and replacement purposes and a 10-foot-wide strip of land immediately adjacent thereto in TMK 9-7-18:20 and the energy corridor portion in TMK 9-7-18:03 for overhang and line sway purposes. An easement for TMK 9-7-18:10, which lies under the H-1 Freeway, will be necessary to accommodate the line's crossing of the freeway.
- 3) **Waiau Power Plant Site:** Portion of land parcel identified as TMK 9-8-03:33 for an overhead crossing of a 138-kV single-circuit transmission line system and portion of land parcel identified as TMK 9-8-04:16 for an overhead crossing of a 138-kV double-circuit transmission line system. The proposed aerial easements would provide for an overhead connection of the lines from HECO-owned properties on both sides of the easement areas.



**PROJECT PARCEL
AT WAIKELE GULCH
SUBJECT TO
NAVY EASEMENT**

**Waiau-
Campbell Industrial Park
Transmission Line Project
Hawaiian Electric Company**

CHRMHILL



Waiau-Campbell Industrial Park Transmission Line Project
Hawaiian Electric Company

LEGEND

—○—	Proposed Alignment
SC	Single Circuit 138 kV Transmission Line
DC	Double Circuit 138 kV Transmission Line
[Hatched area]	Navy parcel subject to easement

PROJECT PARCELS AT WAIAU SUBJECT TO NAVY EASEMENTS

Also, HECO has requested permission to route the 138-kV system through restrictive use easements held by the Navy within the Amfac/JMB Waikeli Business Park. These easements parallel the H-1 Freeway right-of-way in the vicinity of the Paiwa Interchange. Utilities and overhead lighting are permitted improvements under the terms and conditions of these restrictive use easements. However, the proposed easements for the 138-kV system would be granted to HECO by the current land owner, Amfac/JMB Hawaii, Inc.

In each of the areas described above, a combination of foundation and aerial easements will be required for placement of poles and conductors.

3.2.2 Technical Characteristics

3.2.2.1 Configuration

The Waiau-CIP, Part 2, Project will consist of double-circuit and single-circuit 138-kV ac overhead transmission lines from Ewa Nui Substation to the Waiau Power Plant. The alignment from Ewa Nui to the H-1/H-2 Interchange will be a double-circuit overhead alignment. In Pearl City, two overhead single-circuit alignments are proposed: one along Kamehameha Highway and one in the area between the H-1 freeway and Kamehameha Highway. Existing 46-kV lines along the inland boundary of the H-1 freeway and along other sections of the alignment will be restrung to attach to the new poles of the project. Existing 12 kV distribution lines on the seaward side of Kamehameha Highway will be placed underground. Figure 3-3 illustrates the six typical pole, conductor, and insulator configurations that would occur in different locations along the 7.8-mile alignment. Table 3-1 summarizes the design characteristics of the project.

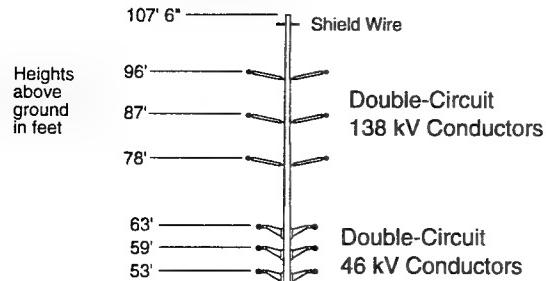
3.2.2.2 Foundations

Soil types along the preferred alignment in the areas of the proposed project consist of Koolau basalt and recent alluvium. Koolau basalt can support heavy foundation loads. Foundations for the overall project will, for the most part, be of the conventional pier type. Pile-type foundations may be required in some locations. Soil boring analyses will take place during the early design stage to determine the best placement of transmission poles.

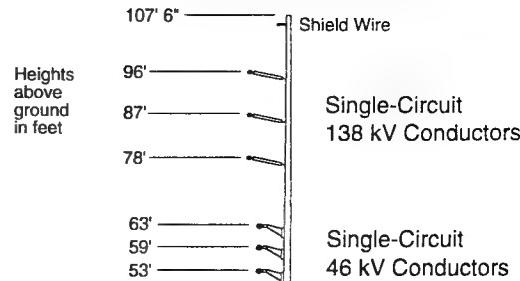
3.2.3 Construction Practices

During the construction of the overhead transmission lines, a number of tasks must be accomplished: surveying, clearing, implementing traffic management, establishing construction facilities or base yards, installing foundations, installing piles in some areas, erecting poles, installing conductors, and cleaning up and removing construction equipment.

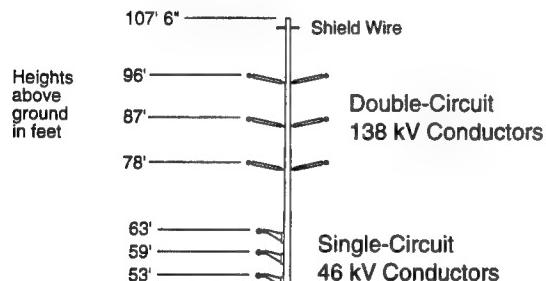
CONFIGURATION #1



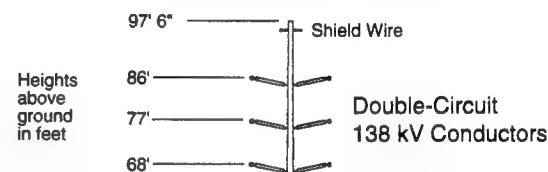
CONFIGURATION #2



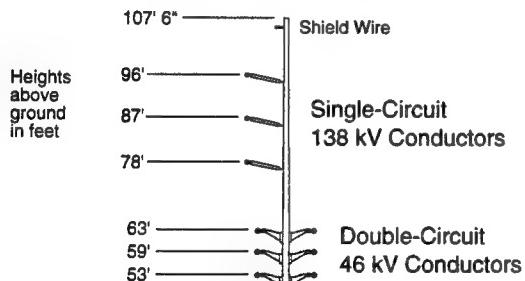
CONFIGURATION #3



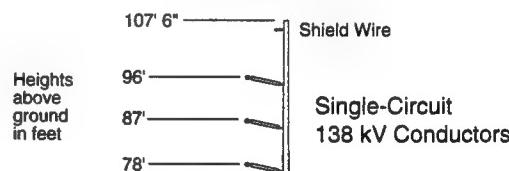
CONFIGURATION #4



CONFIGURATION #5



CONFIGURATION #6



NOT TO SCALE

TYPICAL POLE
CONFIGURATIONS

Waiau-
Campbell Industrial Park
Transmission Line Project
Hawaiian Electric Company
CH2M HILL

FIGURE 3-3

Table 3-1
Waiau-CIP Part 2 138-kV Transmission Line Design Characteristics

	Units
Line length	7.8 miles (approximate)
Type of structure	Tubular steel, single-pole
Structure height	80 to 135 feet
Structure weight	6,000 to 24,000 pounds
Structure foundation type	Augured/reinforced concrete piers or piles
Structure foundation dimensions	Piers: 15 to 25 feet deep; 4 to 6 feet in diameter Piles: 50 to 150 feet deep, approx. 14 feet in diameter
Typical span lengths	300 to 850 feet
Number of structures per mile	6 to 18
Right-of-way width	75 feet average for double-circuit alignment; 40 feet average for single-circuit alignment
Land temporarily disturbed	<ul style="list-style-type: none"> • Foundation 12 feet by 40 feet, or 480 square feet (approx.) • Conductor pulling site 50 feet by 100 feet, or 5,000 square feet (approx.)
138-kV conductor configuration	<ul style="list-style-type: none"> • Bundle description One conductor per phase (three phases per circuit) • Conductor size and type 1,942.6 kcmil¹; ACSR/AW/TWD "Lapwing"² • Conductor ground clearance 30 feet minimum at 212°F, final sag • Shield wire $\frac{3}{8}$-inch AAAC "Amherst"³
Normal operating voltage	138,000 volts ac (138-kV) $\pm 5\%$
138-kV conductor capacity	430 MVA ⁴ normal (1,800 amps) 480 MVA emergency (2,000 amps)

¹Cross-sectional measure of the conductor area in thousands of circular mils.

²Aluminum industry standard code for the conductor and size of strands.

³Aluminum industry standard code for the size and type of wire.

⁴Megavolt-amperes.

3.2.3.1 Surveying Phase

Surveying for the sections of the proposed action that are subject to review in this document has been completed.

3.2.3.2 Clearing Requirements

Right-of-way clearing is done when necessary to prepare for efficient installation of poles and conductors and to provide for required electrical clearances. Because the study area is urban with little high-growing vegetation and because most construction will occur adjacent to existing roadways or within existing easements, very little, if any, right-of-way clearing will be required.

3.2.3.3 Traffic Management Practices

When poles are installed adjacent to roads, part of the road must sometimes be occupied by equipment used for installation of foundations, poles, and conductors. Work on public roads must follow traffic control procedures prescribed by the Federal Highway Administration, the State Department of Transportation Highways Division, and the City and County of Honolulu Department of Transportation Services. Work adjacent to a state road or highway requires a Permit to Perform Work on State Highways, which must incorporate a Traffic Control Plan approved by the Highways Division. The City and County of Honolulu requires observation of state and federal traffic control regulations for any work on county roads.

3.2.3.4 Construction Support Facilities

A construction yard headquarters will be identified in a location near the new line's route. The headquarters is the base station where employees report at the start and end of each day's activities. These facilities are used for other activities, including field office; pole and davit arm laydown areas; storage of materials, equipment, and vehicles; and security.

One material storage yard or staging area will probably be used during construction of the overall project. It will likely be located on HECO property or adjacent to the Waiau Power Plant.

3.2.3.5 Foundation Installation

The next phase in the construction of transmission lines is foundation installation. Foundations for the Waiau-CIP Part 2 line will, for the most part, be of the conventional pier type. Pile-type foundations may be required in some areas.

Pier installation requires boring a large-diameter hole in the ground and placing a reinforcing steel and anchor bolt cage in the hole. Each hole is then filled with concrete to a depth of 2 feet below finished grade. While the concrete is curing, backfill is placed and compacted,

as necessary, around the foundations. If holes fill with water during auguring or hole walls are unstable, a corrugated steel culvert pipe is lowered or driven as a form. Concrete is then placed in the hole via a tremie pipe, allowing water to be pumped out for conventional completion of the work. Concrete is allowed to cure for a period of 2 to 4 weeks before the poles are placed on the foundations.

Pile-type foundations (if required) entail pile-cap excavations approximately 10 to 14 feet by 13 to 18 feet deep; driving 6 to 12 piles 50 to 150 feet deep; tying the pile cap into the reinforced steel of the piles and pouring a concrete cap; and replacing the overburden (approximately 2 feet of soil).

Typically, two to three foundations at a time are excavated, formed, and poured, requiring 2 to 3 weeks to complete. If the poles are located next to a roadway, foundation installation requires coning off a single lane of traffic for approximately 1,000 to 1,500 feet. The coned area is moved forward as the foundations are completed.

3.2.3.6 Pole Assembly and Installation

After the foundation concrete is cured, the poles are transported to the pole locations and are assembled and erected. A mobile crane is used to lift each assembled pole or section into place. After the poles are erected, a 6-inch layer of grout is packed under the steel pole.

The base section of each steel pole is fitted with a baseplate having an array of anchor bolt holes that match the anchor bolt pattern installed in the foundation. Anchor bolt leveling nuts are tightened in accordance with the manufacturer's recommendations before the pole is erected. Insulator hardware is assembled and installed on each pole after it is erected.

Approximately two to four poles per day can be erected by four to seven workers.

3.2.3.7 Conductor Installation

Before conductor installation begins, temporary clearance structures may be installed at road crossings and at locations where the conductors might inadvertently contact existing electrical or communication facilities and vehicular traffic during installation.

"Tension-stringing" is used to install the conductors. This method prevents the conductors from touching the ground or other objects by maintaining a certain tension and sag during the stringing operation. The conductors, the tensioner, the puller, and other related equipment and material are assembled at sites located along the route at 1- to 2-mile intervals. A pulling line or sock line, which is usually a dacron or nylon rope, is pulled from pole to pole through pulleys (sheaves) attached to the insulators. The conductor is then pulled through the sheaves behind the sock line, brought to a specified ground clearance (sag), and clipped in the dead-end or suspension insulator clamps.

In pole locations adjacent to roadways, one lane would be closed to traffic during pulling and sagging operations. Approximately 1 month is required to complete 1 mile of conductor installation.

3.2.3.8 Quality Control, Cleanup, and Removal of Construction Materials

As sections of the transmission lines are completed, HECO thoroughly inspects the work to verify that the lines are built according to specifications and standards. Anything that does not comply is corrected.

Cleanup work generally includes:

- Removing all temporary crossing and clearance structures and backfilling any remaining holes used for temporary poles
- Disposing of packing crates, reels, shipping material, and debris
- Dressing roads, work sites, and pole sites to remove ruts, and leveling and preparing areas for seeding, if required
- Repairing gates and fences to their original condition or better
- Grounding fences and trellises, as needed
- Repairing any damage that occurred during construction

3.2.4 Right-of-Way Acquisition and Use

Three specific areas of the proposed Waiau-CIP, Part 2, Project require that proposed transmission line conductor and/or pole locations use Navy property or existing Navy easements for foundations and/or aerial easements. If the Navy grants HECO an easement for its facilities near Waikele Gulch and the Waiau Power Plant, the Navy retains title to the land and use of the easement area.

Land use activities within and adjacent to the transmission line right-of-way would be permitted within the terms of the easement, insofar as they do not interfere with line operation or compromise safety. In addition, HECO standard easement documents include a landscaping clause that allows HECO to control vegetation growth. Low-growing vegetation may be left in the right-of-way.

3.2.5 Project Schedule, Cost, and Work Force

Construction of the transmission line will take about 12 months. Operation of the transmission line is anticipated by August 1995. The preliminary capital cost for the transmission lines

is \$31.2 million (1991 dollars), which includes the placement of existing 12-kV lines underground.

The construction work force for the Waiau-CIP, Part 2, Project will consist of between 30 to 40 workers. Foundation construction, pole erection, and stringing will be performed by contractors.

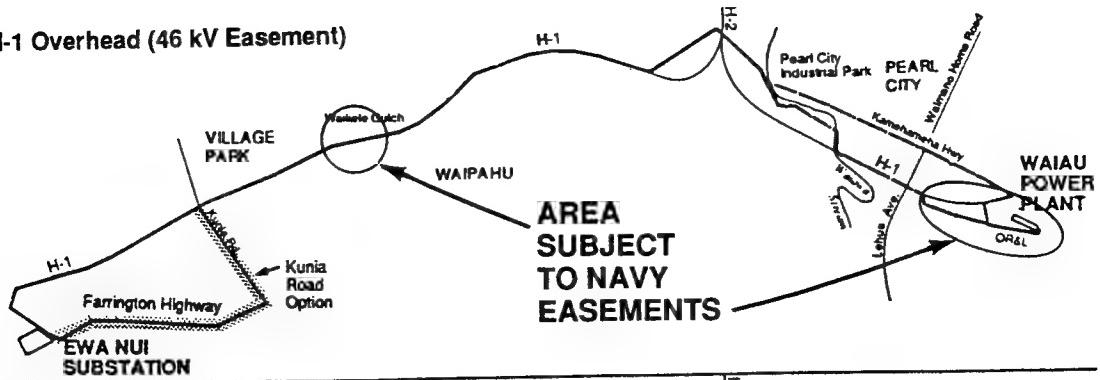
3.3 Alternatives Considered

The Routing Report (February 1992) for the Waiau-CIP, Part 2, Project identified and analyzed potential transmission line corridor and alignment alternatives. Three potential corridors and five potential alignment alternatives, in addition to the no-action alternative, were carried forward in the State Final EIS (August 1992) for the project. One corridor generally followed the H-1 freeway, one followed Farrington Highway, and the third generally followed the Oahu Railway and Land Company (OR&L) right-of-way. A fourth corridor along Waipahu Road was eliminated before the State EIS process was initiated because of severe environmental and engineering constraints.

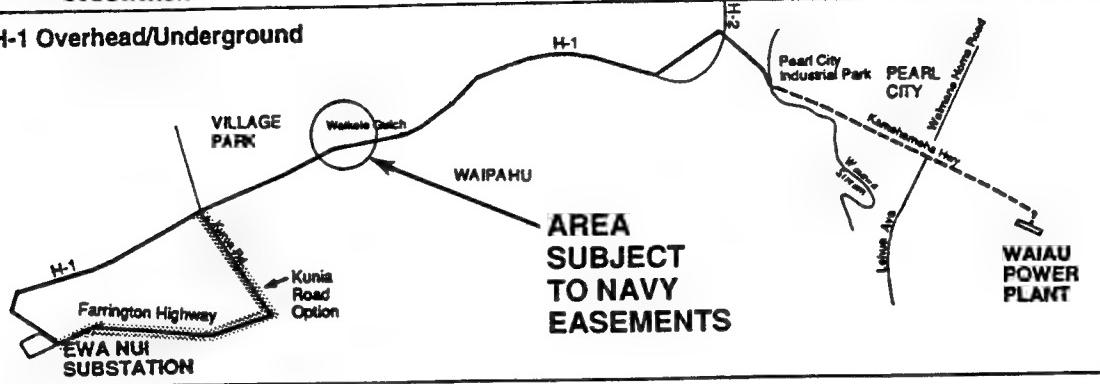
Following a thorough consideration of environmental, engineering, and permitting issues, as well as a review of public, agency and landowner comments, HECO selected a preferred alignment for the Waiau-CIP Part 2, Project. Other alternative alignments considered are listed below and described in this subsection (Figure 3-4):

- No-Action Alternative
- 46-kV Easement (for use with H-1 Overhead Alternative)
- H-1 Overhead/Underground Alternative
- Farrington Overhead Alternative
- Farrington Underground Alternative
- OR&L Overhead/Underground Alternative
- Upland Oahu Sugar Lands Overhead

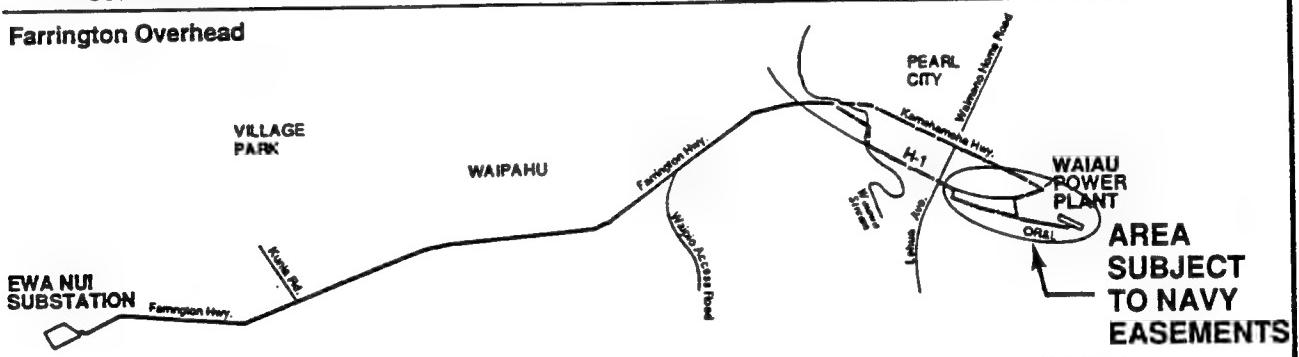
H-1 Overhead (46 kV Easement)



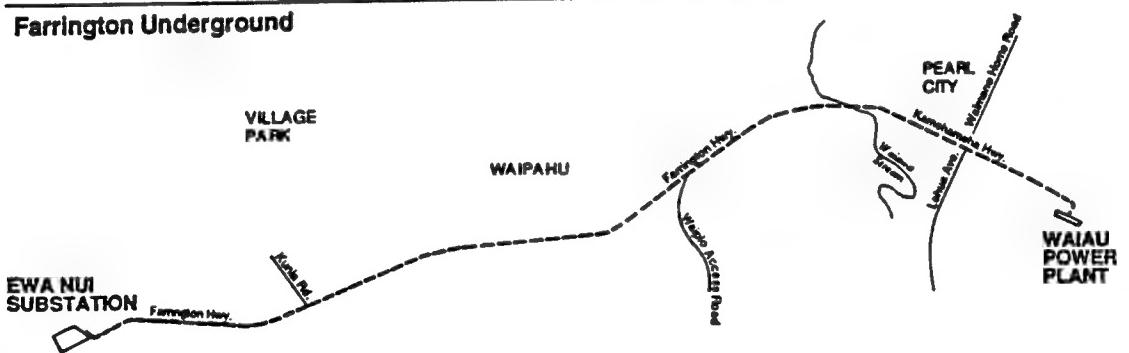
H-1 Overhead/Underground



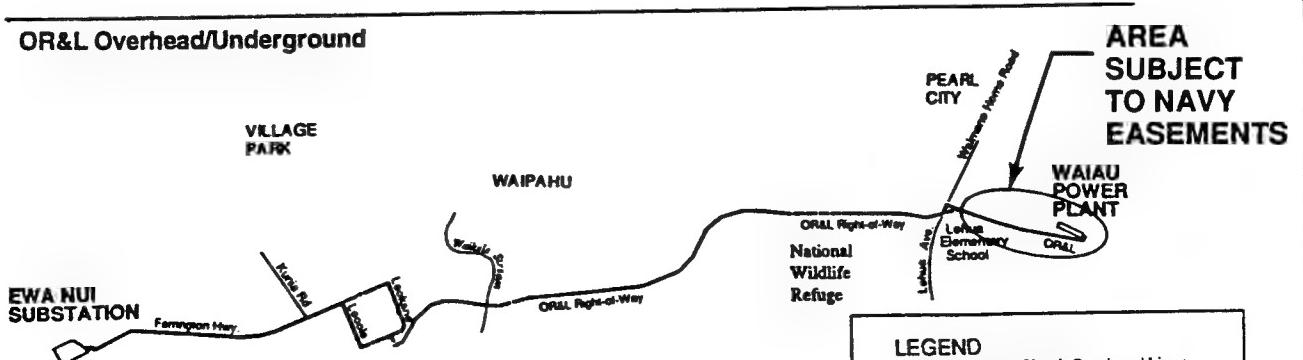
Farrington Overhead



Farrington Underground



OR&L Overhead/Underground



LEGEND

- Double Circuit Overhead Lines
- Double Circuit Underground Lines
- - - Single Circuit Overhead Line

FIGURE 3-4

PART 2 ALTERNATIVE ALIGNMENTS

3.3.1 No-Action Alternative

Under the no-action alternative, it is assumed that neither the portion of the Waiau-CIP, Part 2, Project subject to Navy easements nor the overall transmission line project would be constructed. There would be no construction, operation, or maintenance impacts to the overall project area. HECO electrical transmission and distribution system for Oahu would not achieve improved system reliability, and would therefore remain vulnerable to blackouts related to line outages. In addition, both Part 1 and Part 2 of the Waiau-CIP line are needed to transmit power generated by independent power producers in the CIP area. Because the alternative does not meet the purpose and need criteria of providing reliability and additional capacity, it was not selected as the preferred alternative.

3.3.2 46-kV Easement Alternative (H-1 Overhead)

This alternative was the original preferred alignment presented in the Routing Report (February 1992) and in the state FEIS (August 1992) as the H-1 Overhead Alternative. The westernmost section of this alignment followed an existing 46-kV easement across Navy property in the Pearl City Peninsula. The Navy requested that the line be moved to the area of the bike path on Navy property instead of using the existing 46-kV easement for the new 138-kV transmission line. Under this alternative, permanent steel poles would replace the temporary wooden poles in the existing 46-kV easement. This alternative conflicts with the Navy's future plans to develop the area in which the existing 46-kV easement is located. Permanent steel poles would divide the parcel and limit development potential. Because of this land use conflict, this alternative was not selected as a viable option for further evaluation.

3.3.3 H-1 Overhead/Underground Alternative

Underground lines are more difficult to maintain and repair, have greater surface and subsurface impacts, and are extremely expensive to construct compared with overhead lines. Although the underground section of this alternative would avoid the need for Navy easements, the overhead sections would require Navy easements. This alternative was eliminated from further consideration because of its high cost and resulting impacts to ratepayers.

3.3.4 Farrington Overhead Alternative

Adverse visual impacts, traffic disruption during construction and maintenance, and the potential for discovery of cultural resources would result from this alternative. The overhead lines would conflict with a proposed rapid transit fixed guideway, and one of the single-circuit lines along Kamehameha Highway would pass over a proposed transit station. Navy easements would be required in the area of the Waiau Power Plant. This alternative was eliminated from further consideration when the Hawaii DOT and the City and County of Honolulu stated they would not permit the alternative because of conflicts with the rapid transit alignment along Farrington Highway listed on the Development Plan Facilities Map.

3.3.5 Farrington Underground Alternative

The impacts of this alternative would be the same as those described above for the Farrington Overhead Alternative except that there would be no visual impacts in the underground section. However, underground lines are more costly to install. In addition, repair of underground lines takes longer and causes more traffic disruption than does the repair of overhead lines. Although no Navy easements would be required, this alternative was eliminated from further consideration because of its high cost and resulting impacts to ratepayers.

3.3.6 Oahu Railway & Land Overhead/Underground Alternative

This alternative presents the most significant adverse impacts. Visual and biological resources along the shoreline could be negatively impacted by placement of the transmission lines next to existing wetlands and wildlife habitat (including a National Wildlife Refuge). Severe soil instability and potential liabilities relating to the existing oil and gas lines beneath the alignment are significant problems. Also, an old landfill near the alignment may have contaminated soils. Underground portions of the line would present significant maintenance difficulties. However, the alternative is located in a low-density urban development area, and therefore traffic impacts during construction and maintenance would be less. Navy easements would be required near the Waiau Power Plant. This alternative was eliminated from further consideration because of the potentially unlimited liability (cost and environmental damage) to HECO. The probability that existing oil pipelines could be damaged during construction of the transmission lines and that the oil pipelines in the alignment could leak their contents after construction was considered high.

3.3.7 Uplands Oahu Sugar Lands Overhead

This alternative would begin at the Ewa Nui Substation and follow the H-1 Freeway to Kunia Road. In order to utilize the upland portions of the Oahu Sugar Lands, the transmission line would need to be directed inland along Kunia Road to a point above the existing Village Park community. The line would then continue behind Village Park to the Naval Reservation boundary, where it would return to the proposed H-1 alignment by going through Navy lands. This alternative was advocated by Hawaii U.S. Congresswoman Patsy Mink as a way to avoid the existing Village Park community. However, this alternative would conflict with the proposed Royal Kunia residential development and would place more residential units in close proximity of the line as would the preferred alternative. In addition, this alternative would require additional easements from the U.S. Navy and would be more expensive to construct than the preferred alternative. As a result, this alternative was not evaluated further.

3.4 Summary

The proposed alignment for the Waiau-CIP 138-kV Transmission Line, Part 2, Project, as approved by the Public Utilities Commission, will go from the Ewa Nui Substation to the Waiau Power Plant along the H-1 Freeway. The PUC established that this alignment best met the purpose and need criteria outlined in Chapter 2 in the most efficient manner from a cost and environmental impact perspective. The no action alternative was eliminated because it would not meet the reliability and capacity criteria established for the overall project. Use of alternatives which would not need a Navy easement in the Waikale Gulch were eliminated as too costly or because they would place more residential units in close proximity of the line in the future. The alternative which would not require the proposed easements near the Waiau Power Plant was eliminated by the U.S. Navy as it would create land use conflicts on Navy lands and would restrict future development potential. The granting of easements within the proposed parcels to HECO by the U.S. Navy represents the most cost efficient and effective alternative available to meet the purpose and need criteria. A comparison of potential impacts for the various alternatives can be seen in Table 3-2.

IMPACT AREA	46 kV Easement (H-1 Overhead Alternative)	H-1 Overhead/Underground Alternative	Farrington Overhead Alternative	Farrington Underground Alternative	OR&L Overhead/Underground Alternative	Uplands Oahu Sugar Lands Alternative	No-Action Alternative
Land Use							
Demographics							
Employment							
Visual Resources							
Health Effects of Electric and Magnetic Fields							
Biological Resources							
Water Resources							
Soil Resources							
Transportation/Transit							
Traffic							
Utilities							
Pipelines							
Hazardous Wastes							
Air Quality							
Noise							
Cultural and Historic Resources							
Public Services							
Maintenance							
Construction Costs							
Electric Service Reliability							

LEGEND

- No Adverse Impact
- Minor Adverse Impact (may not be significant)
- Adverse Impact (may be significant)
- Inconclusive

TABLE 3-2

SUMMARY OF IMPACTS

Waiau—
Campbell Industrial Park
Transmission Line Project
Hawaiian Electric Company

CH2M HILL

Chapter 4

Existing Environment

For purposes of analysis, the State FEIS for the Waiau-CIP, Part 2, Project divided the overall project area into three sections: Ewa, Waipahu, and Pearl City. Portions of the overall Waiau-CIP, Part 2 Project area subject to the proposed Navy action are located in the Waipahu and Pearl City sections of the preferred alignment. This chapter describes the existing conditions within these two sections and refers more specifically to those areas subject to Navy easements.

Some of the figures in this chapter show an area larger than that of the proposed action. Existing and proposed land uses are shown in Figures 4-1 and 4-2.

4.1 Land Use

4.1.1 Waipahu Section

Land uses in the Waipahu section of the proposed action reflect a high-density, urban development pattern, with a predominance of single-family and multifamily residential development. Inland of the H-1 freeway east of Kunia Road is primarily single-family housing up to the edge of Waikele Gulch, next to which a Navy easement over Military Road is required. On the seaward side of H-1, single-family residential development fills the area between the H-1 freeway and Farrington Highway.

The Lualualei Naval Magazine (NAVMAG) has three branches, one of which (Waikele) is within the Waipahu section of the study area. The Waikele Branch, occupying about 518 acres, is located in south-central Oahu, about one-half mile north of Waipahu Town. The Waikele and Kipapa Streams enter and then converge within the Waikele Branch. Major tenants of this installation are the U.S. Army Support Command Hawaii and Navy Manpower Engineering Center Detachment Pearl Harbor. The major activity at the Waikele Branch was the storage of ordnance in a total of 120 cave magazines, 8 earth-covered magazines, and an open storage pad. The Waikele Depot is no longer used to store ordnance. The Pearl Harbor Naval Base Complex consists of a core area within the controlled area of the Naval Complex as well as adjacent, noncontiguous facilities. A portion of the Pearl Harbor Naval Complex lands is located on Waipio Peninsula, including Beckoning Point. Most of Waipio Peninsula is in the ESQD zone and is used for military purposes.

Farther east along the inland side of the H-1 freeway by Paiwa Interchange, the Amfac Waikele residential development between Waikele Gulch and the Waiawa Interchange is being constructed in phases. Within the Amfac Waikele project area, a 17.2-acre retail complex is proposed for the area east of Paiwa Road. In anticipation of the need to provide highway access to this area, a new interchange with the H-1 freeway was recently constructed at Paiwa Road.

In Waipahu, churches, police facilities, fire stations, and city and county buildings and offices are distributed throughout the entire area. Waipahu has a number of elementary, middle, and high schools to serve the local population. It also has several parks and recreational amenities, including Waipahu Cultural Garden Park, Hans L'Orange Park, and Waipahu Field.

4.1.2 Pearl City Section

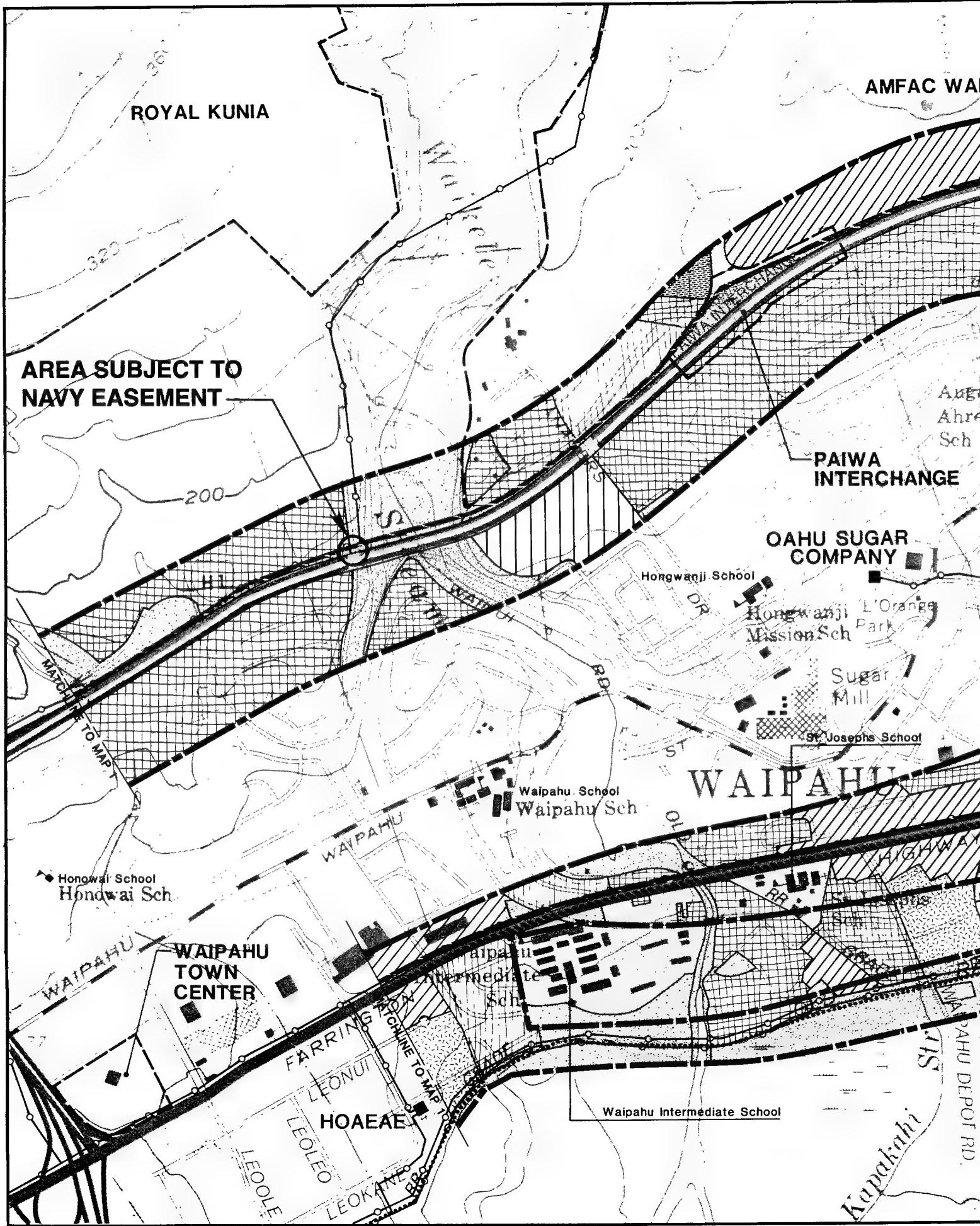
Pearl City has the greatest mix of land uses and the highest density. The Waiawa Interchange and major thoroughfares in this section occupy a substantial amount of the land area of the preferred alignment. The Waiau Power Plant is located at the east end of the Pearl City section, where several large parcels are developed for industrial use. The power plant is the terminus of the Waiau-CIP, Part 2, Project and a major utility in the Pearl City area. It is also a significant element of HECO's facilities serving the Island of Oahu. Other utilities in the Pearl City section include a wastewater treatment plant and water tanks on the west side of the Pearl City Peninsula.

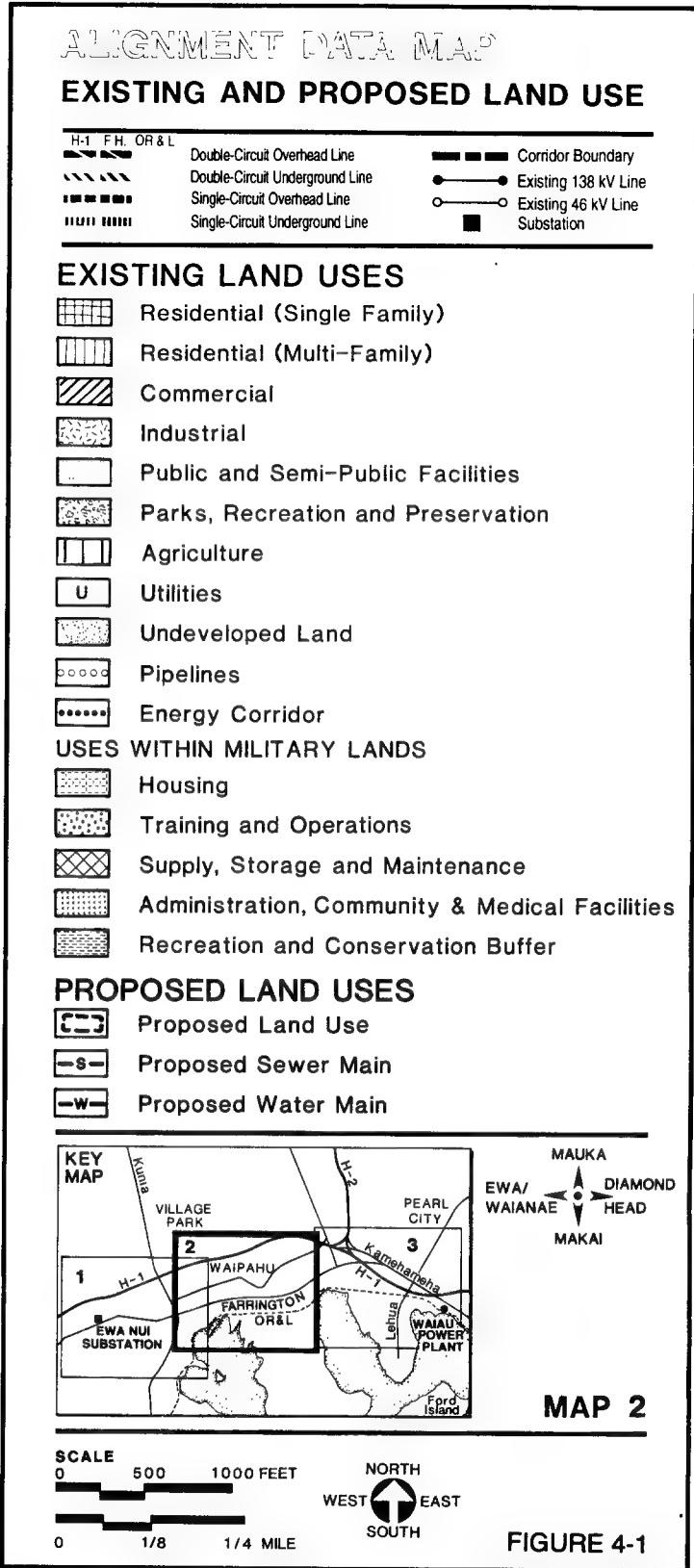
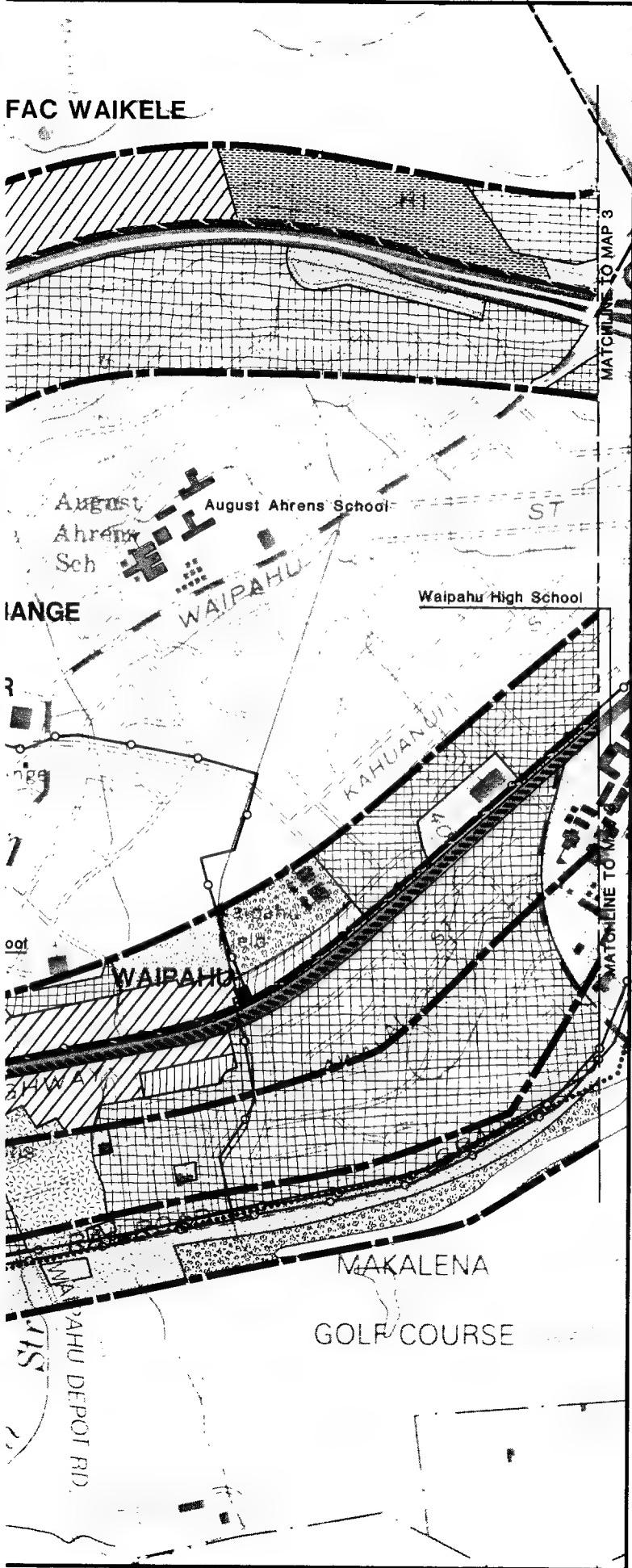
A portion of the Pearl Harbor Naval Complex lands is located on the Pearl City Peninsula and contains industrial, residential, and recreational uses. Light industrial uses are located near the Waiau Power Plant, inland of both the Kamehameha Highway and the H-1 freeway. A bike path originates on Navy property just east of Lehua Avenue in the vicinity of Lehua Elementary School and runs easterly adjacent to the H-1 freeway to Waimano Stream. There it crosses onto HECO property and continues in a southeasterly direction through agricultural land, then through the Waiau Power Plant site and beyond.

A portion of the proposed action is within the Waiau Power Plant Special Management Area (SMA), as shown in Figure 4-3. Hawaii's Coastal Zone Management (CZM) Office created SMAs "...to avoid permanent losses of valuable resources and the foreclosure of management options, to ensure the adequate access, by dedication or other means, to publicly owned or used beaches, recreation areas, and natural reserves is provided." As part of the CZM program, the City and County of Honolulu's Department of Land Utilization (DLU) designates and administers the SMA along the coast of Oahu. Figure 4-3 shows the portion of the proposed action that is within the Waiau Power Plant SMA. An SMA Use Permit for the overall project was granted by the City Council of the City & County of Honolulu on February 17, 1993. A CZM federal consistency determination for the proposed project subject to Navy easements was filed with the Hawaii Office of State Planning and is contained in the appendix.

Small farming operations remain within Pearl City. Seaward of Leeward Community College, a watercress farm lies between the OR&L right-of-way and Kamehameha Highway. Several other wetland farming sites are found in the area west of the Waiau Power Plant. Undeveloped land is relatively scarce within the Pearl City section.

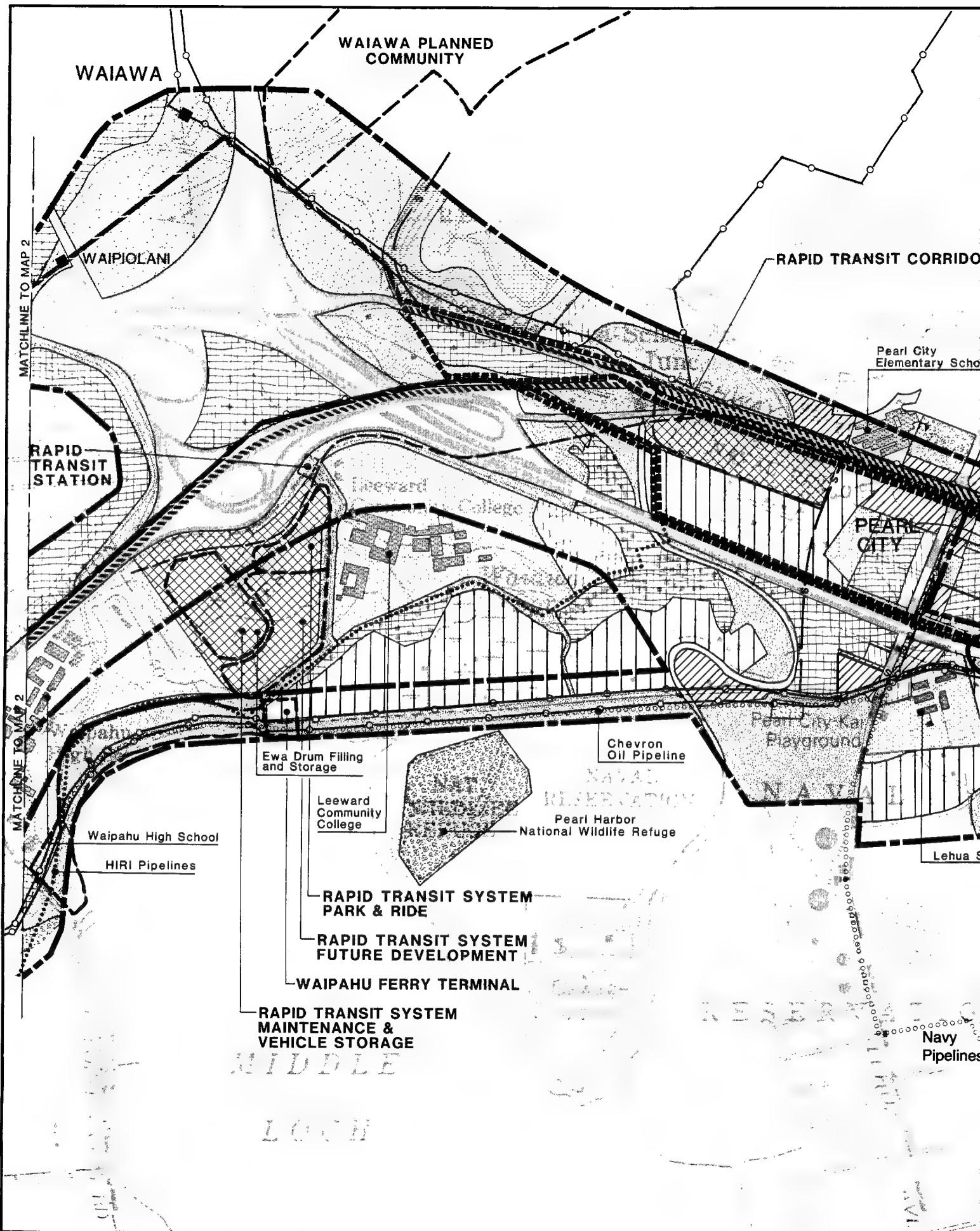
A proposed rapid transit fixed guideway alignment is shown on the Development Plan Facilities Map. The proposed alignment follows Kamehameha Highway through Pearl City. A transit station is proposed near Waimano Home Road.

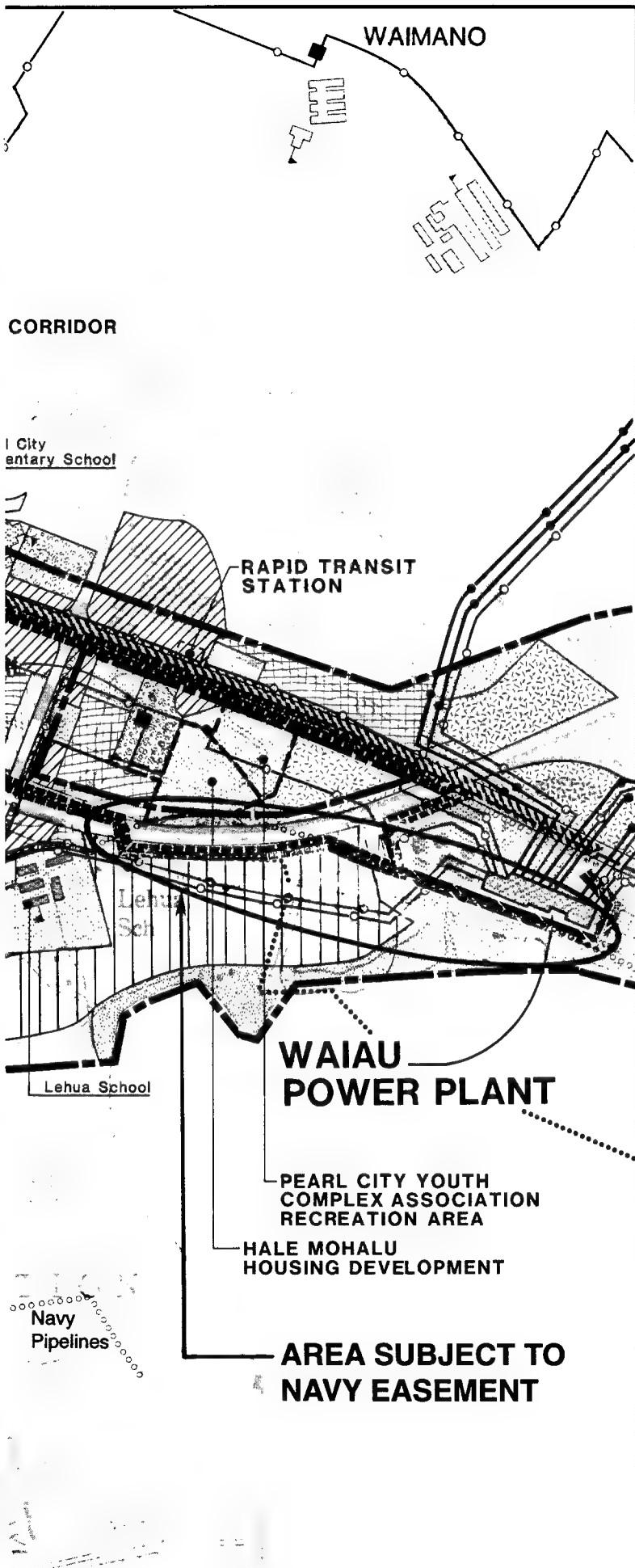




Waiau – Campbell Industrial Park Transmission Line Project
Hawaiian Electric Company

CHM HILL





EXISTING AND PROPOSED LAND USE

H-1 FH OR&L	Double-Circuit Overhead Line
.....	Double-Circuit Underground Line
—	Single-Circuit Overhead Line
—·—	Single-Circuit Underground Line
■	Substation

EXISTING LAND USES

- [Residential Single Family]
 - [Residential Multi-Family]
 - [Commercial]
 - [Industrial]
 - [Public and Semi-Public Facilities]
 - [Parks, Recreation and Preservation]
 - [Agriculture]
 - [Utilities]
 - [Undeveloped Land]
 - [Pipelines]
 - [Energy Corridor]
- USES WITHIN MILITARY LANDS**
- [Housing]
 - [Training and Operations]
 - [Supply, Storage and Maintenance]
 - [Administration, Community & Medical Facilities]
 - [Recreation and Conservation Buffer]

PROPOSED LAND USES

- [Proposed Land Use]
- [Proposed Sewer Main]
- [Proposed Water Main]

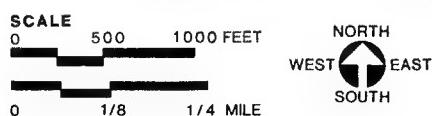
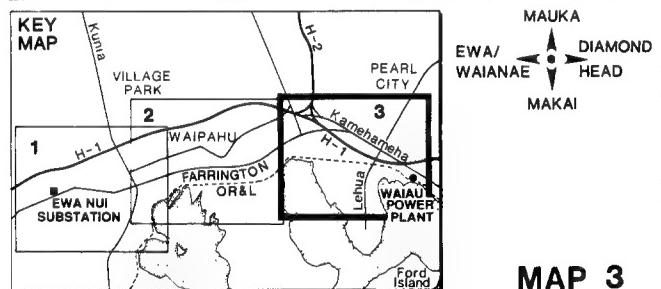
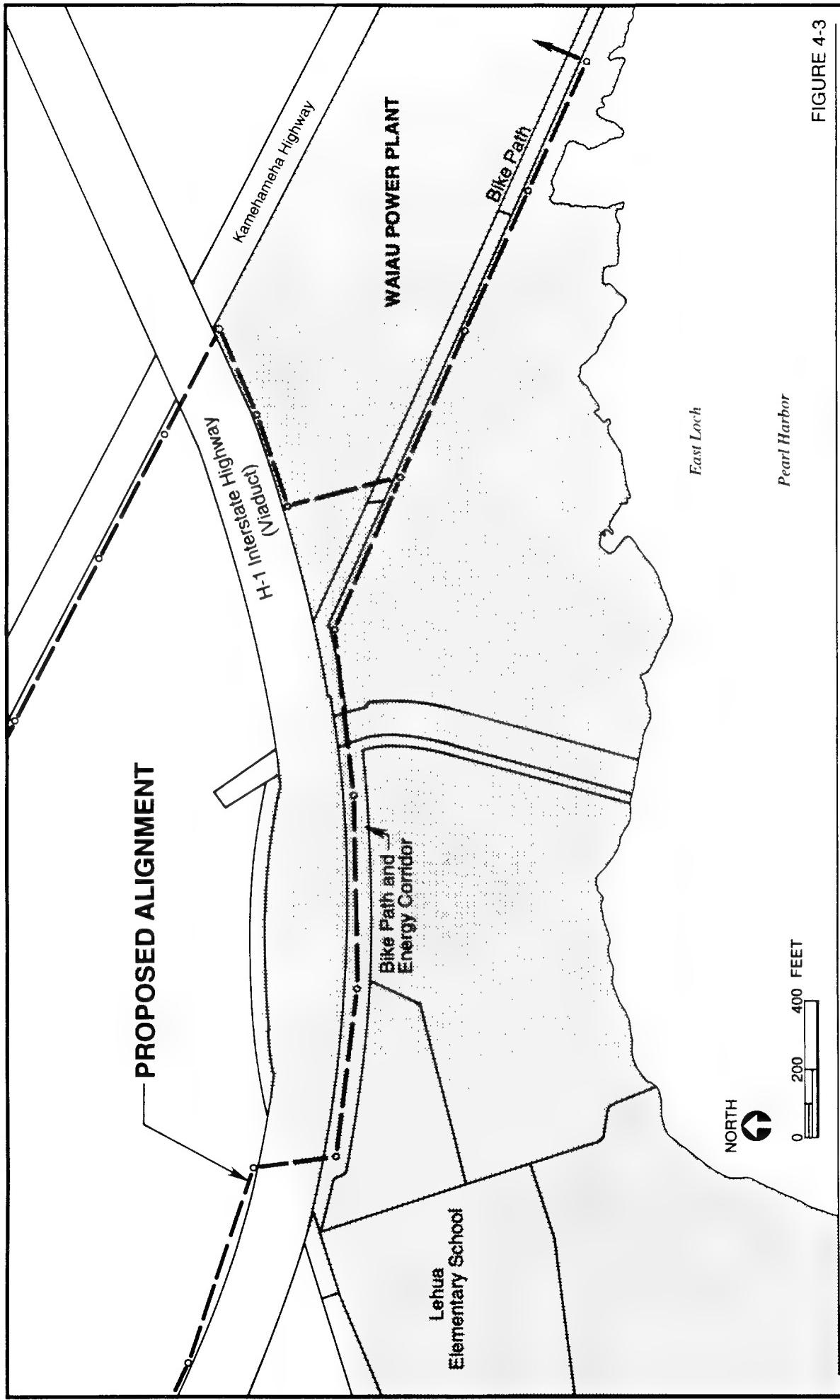


FIGURE 4-2

Waiau – Campbell Industrial Park Transmission Line Project
Hawaiian Electric Company

CHM HILL



**Waiau-
Campbell Industrial Park
Transmission Line Project**
Hawaiian Electric Company

CARMHILL

In the Pearl City residential community, residences are located primarily inland of Kamehameha Highway but are scattered throughout the area. Single-family units make up the great majority of the housing stock. Kamehameha Highway is an important strip of highway commercial activities.

Pearl City also contains churches, police stations, fire stations, and City and County of Honolulu buildings and offices, distributed throughout the entire area. A number of elementary, middle, and high schools serve the local population, including Pearl City Elementary School, Leeward Community College, Pearl City Highlands Elementary and Intermediate Schools, and Pearl City High School.

4.2 Visual Resources

The *Coastal View Study* (City and County of Honolulu, 1987) describes the visual resources in the Pearl Harbor area of the south shore of the Primary Urban Center District.

For the Pearl Harbor area, the *Coastal View Study* notes that:

The Pearl Harbor section consists of the area surrounding Pearl Harbor, including Waipahu, Pearl City and Aliamanu. The flat terrain and the built up military facilities surrounding Pearl Harbor provide very little public viewing opportunities into this bay. The best views of the bay are from the upper residential areas of Pearl City and Waipio where an overview of the harbor can be seen.

With respect to the Pearl City section that contains the alignment, the *Coastal View Study* states:

Even within its urban context, the development on the coastal roadways (Farrington Highway and Kamehameha Highway) are fairly jumbled, representing low visual unity and urban intactness.

The City and County of Honolulu's General Plan (1988) lists the following two general objectives for public views (these identify no specific view, dominant feature, or particular characteristic for the area):

- In order to promote pleasing and attractive living environments in existing new neighborhoods, mountain and ocean views, and views of central Honolulu shall be protected whenever possible.
- Views from public streets and thoroughfares to the mountain and sea shall be preserved and enhanced whenever possible.

A field evaluation of visual resources within the project area was conducted during the corridor evaluation stage. The field evaluation of existing conditions described below was used as the basis for evaluating the visual impacts of the transmission line alternatives.

4.2.1 Waipahu Section

4.2.1.1 Views from Village Park

From the inland side of Village Park near Waikeli Gulch, the ocean meets the horizon line in the distance. West Loch lies in the far middleground and the H-1 freeway and Farrington Highway lie in the near middleground. The existing Village Park development and relatively barren hillside occupy the foreground. To the east, the mountains form a backdrop for the twin towers at Pearl City and the Waipahu Sugar Mill; the Waiau Power Plant is visible near the water. The sugar mill, power plant, and military presence near Pearl Harbor create a somewhat industrial image, although the distance removes much of the detail.

Village Park at the H-1 freeway affords a coastal view, with Pearl Harbor's West Loch in the background, Waipahu in the middleground, and the H-1 freeway dominating the foreground. A transmission line parallels the freeway at this point along the inland side. Old Fort Weaver Road is visible to the southwest, dotted with transmission line poles.

4.2.1.2 Views from the H-1 Freeway

The major visual components seen from the H-1 freeway include the freeway itself and a single-family housing development. Along the highway, the nearness of the foothills creates an awareness of the mountain ridge as a backdrop to most development.

The natural topographic conditions tend to orient casual views to the makai side, although the ridgeline and hills provide interesting visual elements. The Waiawa Interchange offers an imposing pattern of urban development and activity featuring the sweeping curves of the interchange ramps as major elements.

4.2.2 Pearl City Section

4.2.2.1 Views from Kamehameha Highway

The area along Kamehameha Highway features a varied mix of high-density land uses. These uses include housing developments, retail shops and shopping centers, restaurants, schools, Naval facilities, and community parks. As such, the visual character as viewed from Kamehameha Highway is one of a rich fabric of high-density urban development with a few high-rise structures. The visual character of this area is distinctly urban, with substantial activity in terms of pedestrian and vehicular traffic.

4.2.2.2 Views From the H-1 Freeway

The H-1 freeway is elevated in this section, raising the viewer above the generally low-rise urban landscape at street level. As with the H-1 freeway section in Waipahu, the casual viewer would be aware of the adjacent commercial and residential areas on the inland side, but would tend toward makai views of Pearl Harbor.

4.3 Electric and Magnetic Fields

Overhead transmission lines are a vital part of the system that provides electric service to homes and businesses in Hawaii. In recent years, interest has been growing concerning potential effects that may be associated with the environment around transmission lines—in particular, potential health effects of electric and magnetic fields (EMF). The following subsection summarizes the major points of a technical report (Enertech Consultants, 1992) and provides updated information based on testimony in 1993 before the Hawaii Public Utilities Commission (Docket 7256).

4.3.1 Transmission Line Voltage Classification

High-voltage transmission or bulk power lines form the backbone of the electric energy distribution system. A network of about 338,000 circuit-miles of transmission lines is in service in the United States. On Oahu, 170 circuit-miles of 138-kV lines form the island's transmission system. The proposed Waiau-CIP Part 2 lines will be operated at 138-kV, the highest voltage classification used in Hawaii. In contrast, this voltage is the lowest classification of transmission lines in operation in the mainland United States, where lines range up to 765 kV.

4.3.2 Electric Fields

Electric fields are a result of the voltage or electric potential on an object. Any object with an electric charge on it has a voltage at its surface caused by the accumulation of more electrons on that surface compared with another object or surface. The voltage effect is not limited to the surface but exists in the space surrounding the object. The change in voltage over distance is known as the electric field. The units describing an electric field are volts per meter (V/m) or kilovolts per meter (kV/m). The electric field is stronger near a charged object and decreases rapidly with distance from an object.

Electric fields are a common phenomenon. Static electric fields can result from taking off a sweater or walking across a carpet. Most household appliances and other devices that operate on electricity create electric fields. The electric field is a result of the voltage on the appliance, and the field decreases rapidly with distance. The fields that result from point-source household appliances generally decrease more rapidly with distance than fields from line sources such as power lines. Appliances need not be in operation to create an electric field; an electric field occurs whenever an appliance is connected to an electrical outlet. Typical values measured at 12 inches from some common appliances are shown in Table 4-1.

Table 4-1
Typical Electric Field Values for Household Appliances
(at 12 inches)

Appliance	Electric Field (kV/m)
Electric blanket	0.25 ^a
Broiler	0.13
Stereo	0.09
Refrigerator	0.06
Iron	0.06
Hand mixer	0.05
Phonograph	0.04
Coffee pot	0.03

^a1 to 10 kV/m next to blanket wires (Enertech Consultants, 1985).

Source: Carstensen, 1985.

4.2.3 Magnetic Fields

An electric current flowing in any conductor (e.g., electric equipment, household appliance) creates a magnetic field. The most commonly used unit for measuring magnetic fields is the Gauss (G), which is a measure of the magnetic flux density (intensity of magnetic field attraction per unit area). The unit mG (or milliGauss) is equal to one-thousandth of a Gauss.

The magnetic field under transmission lines is relatively low in comparison with measurements near many household appliances and other equipment. The magnetic field near an appliance decreases rapidly with distance from the appliance. The magnetic field also decreases with distance from line sources, such as power lines, but not as rapidly as from appliances. Because the magnetic field is caused by the flow of an electric current, a device must be in operation to create a magnetic field. The magnetic fields of a large number of typical household appliances were recently measured by the Illinois Institute of Technology Research Institute (IITRI) for the U.S. Navy (Gauger, 1985) and by Enertech Consultants (Silva, 1988) for the Electric Power Research Institute. Typical values of magnetic fields associated with household appliances are given in Table 4-2.

Table 4-2
Typical Magnetic Field Values for Household Appliances

Appliance	Magnetic Field (mG)	
	12 Inches Away	Maximum
Electric range	3-30	100-1,200
Electric oven	2-5	10-50
Garbage disposal	10-20	850-1,250
Refrigerator	0.3-3	4-15
Clothes washer	2-30	10-400
Clothes dryer	1-3	3-80
Coffee maker	0.8-1	15-250
Toaster	0.6-8	70-150
Crock pot	0.8-1	15-80
Iron	1-3	90-300
Can opener	35-250	10,000-20,000
Mixer	6-100	500-7,000
Blender, popper, food processor	6-20	250-1,050
Vacuum cleaner	20-200	2,000-8,000
Portable heater	1-40	100-1,100
Fans/blowers	0.4-40	20-300
Hair dryer	1-70	60-20,000
Electric shaver	1-100	150-15,000
Color television	9-20	150-500
Fluorescent fixture	2-40	140-2,000
Fluorescent desk lamp	6-20	400-3,500
Circular saws	10-250	2,000-10,000
Electric drill	25-35	4,000-8,000

Source: Gauger, 1985.

Magnetic field measurements were made by Enertech Consultants in February 1992 at several public locations in Waipahu and in January 1990 at several public locations on the Island of Hawaii to characterize everyday magnetic field levels. These measurements were made using an EMDEX II magnetic field meter, which can be worn at the waist. The meter automatically records data every 1.5 seconds and stores the results for readout to a personal computer. The measurement results are summarized in Table 4-3.

Magnetic field measurements were also taken by Enertech Consultants in February, 1992 under and near existing 46-kV and 12-kV lines in Ewa, Village Park, Waipahu, and Pearl City. The measurements ranged from 1 to 11 mG. Electrical loads on the lines were low at the time of measurement. If the power lines had been fully loaded at the time of measurement, then the magnetic field levels would have been higher.

Table 4-3
Summary of Everyday Magnetic Field Levels

Location	Magnetic Field (mG)
Waipahu: Gem's Department Store	0.2-2.5
Gem's Jewelry	10-300
Gem's Parking Lot	0.5-2.0
Times Supermarket	0.5-14
"Skill Crane" Game	12-50
Tokyo Deli	0.5-8
Bakery	2-5
Driving on Farrington Highway	0.5-10
McDonald's Restaurant	0.5-15
Waipahu Sporting Goods	1-5
Arakawa's Department Store	0.5-5
Arakawa's Jewelry	4-120
Hilo: McDonald's Restaurant	1-32
Post Office	0.5-34
State Building	0.2-12
Sure Save Supermarket	0.2-57
Ben Franklin Department Store	0.5-70
J. C. Penney Department Store	0.2-5
7-11 Convenience Store	0.5-8
Liberty House Department Store	0.1-3
Tilt-Video Arcade	1-40
Kay-Bee Toy Store	0.5-28
Puna: Pahoa Post Office	0.3-10
Dairy Queen Restaurant	0.5-12
DA Store-Convenience Shop	0.5-5
Walking past stores on Highway No. 130	0.2-7
Source: Enertech Consultants, 1990 and 1992	

HECO engineers and representatives of the Pearl City Neighborhood Board and the general community made magnetic field measurements at various locations in Pacific Palisades and Pearl City in 1992. These measurements were presented to community representatives as shown in Table 4-4.

Additional magnetic field measurements were made in and around the Village Park subdivision on several occasions in 1993 by different sources. HECO engineers and community representatives made magnetic field measures in February and March, 1993. Sage Associates made measurements in Spring, 1993 at a home next to the proposed transmission line alignment. These various measurements are summarized in Table 4-5.

4.3.4 Electric Field and Magnetic Field Standards

General transmission line safety standards are imposed by the State of Hawaii PUC General Order No. 6 (Rules for Overhead Electric Line Construction) and the National Electric Safety Code.

The Hawaii State Department of Health issued, on January 9, 1994, a statement entitled, "DOH Policy Relating to Electric and Magnetic Fields from Power-Frequency Sources." This statement replaces an earlier one issued on April 3, 1991. The new statement reads as follows:

The Department of Health, in response to continuing but inconclusive scientific investigation concerning electric and magnetic fields (EMF) from low-frequency power sources, recommends a "prudent avoidance" policy. "Prudent avoidance" means that reasonable, practical, simple, and relatively inexpensive actions should be considered to reduce exposure.

A cautious approach is suggested at this time concerning exposure to electric and magnetic fields (EMF) around low-frequency sources, such as electric appliances and power lines. The existing research data on possible adverse health effects, including cancer, are inconclusive and not adequate to establish or quantify a health risk. For example, the biological mechanisms that might underlie any apparent relationship between EMF and cancer have yet to be clearly defined. Also, some epidemiological studies suggest that, if these fields increase the risk of cancer, it is a very small increase. Other epidemiological studies suggest that there is no increased risk.

The Department of Health will continue to collect and evaluate information on possible health hazards associated with electric and magnetic fields. If adequate data ever become available to establish what levels may be harmful, appropriate standards will be established.

Table 4-4
Magnetic Field Levels
Pacific Palisades and Pearl City

Time (a.m.)	Location	Magnetic Field (mG)
9:10	Residential driveway	2.24
9:13	Manana Trail driveway	6.16
9:15	Manana Trail checking station	5.76
9:17	Under 138-kV Line #1	72.00
9:21	Under 138-kV Line #2	22.40
9:25	Under 138-kV Line #3	108.00
9:37	Pole #71—next to transformer	13.00 to 28.00
9:38	Meter socket	3.70
9:39	Backyard	1.92
9:43	Family room—in front of T.V. (on)	16.40
9:44	Family room—in front of T.V. (off)	1.76
9:45	Family room—on side of T.V. (on)	43.60
9:46	Family room—at couch (T.V. on)	1.48
9:49	Microwave (on)	100.00
9:49	Microwave (off)	3.76
9:50	Range hood (on)	13.60
9:50	Range hood (off)	3.20
9:50	Computer at 2 feet away (on)	3.20
9:51	Computer at screen (on)	22.00
10:06	Cellular telephone recharger (on)	364.00
10:45	Intersection of Kuala and Kamehameha Highway—inland corner	2.24
10:57	Waiau Power Plant parking lot—inland/east corner	86.00
11:02	Kamehameha Highway—seaward side under 138-kV Line #2	9.80
11:04	Kamehameha Highway—seaward side under 138-kV Line #3	22.80
11:10	Kamehameha Highway—seaward side Pole 233 next to <ul style="list-style-type: none"> • 12-kV overhead to underground circuit riser—metal casing • 12-kV overhead to underground circuit riser—PVC casing 	204.00 1,460.00
11:12	Kamehameha Highway—seaward side under 138-kV Line #1	16.00
11:25	Noelani Street—under 138-kV lines	46.00
11:23	Intersection of Noelani St. and Hoomalu St.	9.68
11:24	Noelani St. residence on seaward/west side of 138-kV lines	20.40
11:26	Noelani St. residence on seaward/east side of 138-kV lines	19.60
11:42	Lehua Elementary School—inland/diamond head corner of property	1.40
11:56	Kamehameha Highway—seaward side across from Pearl City Elementary School	5.48

Source: HECO field measurements, Saturday, November 14, 1992

Table 4-5
Magnetic Field Levels
Village Park

Source	Location	Magnetic Field (MG)
HECO	Pad-mount transformer at Kaaholo Street: - at pad - 12" away from pad - more than 12" away from pad	10.8 5.0 2.4 to 1.1
HECO	Kaaholo Street residence's backyard adjacent to proposed alignment: - under existing 46-kV and 12-kV lines - 30' away from existing 46-kV and 12-kV lines	4.2 to 4.5 2.0 to 2.2
HECO	Existing 138-kV transmission lines at Kunia Road - under inland circuit - 50' away from inland circuit - 100' away from inland circuit - under seaward circuit - 50' away from seaward circuit - 100' away from seaward circuit	37.2 22.0 9.3 18.4 10.8 5.3
Sage	Kaaholo Street residence adjacent to proposed alignment - at wall of house nearest to power line right-of-way - interior of house	1.0 to 1.1 0.2 to 0.3
Sources: HECO, 1993 Sage Associates, 1993		

The U.S. Environmental Protection Agency issued a booklet (*Questions and Answers about Electric and Magnetic Fields (EMF)*) in December, 1992 in which it stated that neither the EPA nor any other federal regulatory agency has established a standard for EMF because the scientific evidence is inadequate to determine if magnetic fields are harmful, and if they are, at what levels.

On April 7, 1994, the Hawaii Public Utilities Commission (PUC) issued Decision and Order No. 13201 approving the Waiau-CIP Transmission Lines, Part 2, Project as proposed by HECO and as described in this environmental assessment. In reaching its decision, the PUC considered the potential adverse health effects from the project's magnetic fields. Extensive testimony by national experts of different viewpoints was submitted during the evidentiary hearing and related proceedings. In its decision, the PUC adopted the policy of prudent avoidance with respect to EMF from the proposed transmission lines. The PUC's position in the Decision and Order :

...For purposes of this docket and pending adoption of a definition by some other authoritative source, we adopt the following explanation of prudent avoidance, put forth by the United States Environmental Protection Agency in its *Questions and Answers About Electric and Magnetic Fields (EMF)*, 402-R-92-009 (1992):

Prudent avoidance is an approach to making decisions about risks. This decision-making process is based on judgment and values, can be applied to groups and individuals, and can be considered for all aspects of our lives, not just EMFs. Prudent avoidance applied to EMFs suggests adopting measures to avoid EMF exposures when it is reasonable, practical, relatively inexpensive and simple to do. This position or course of action can be taken even if the risks are uncertain and even if safety issues are unresolved.

A few states have some form of electric field standard, and two states (Florida and New York) have a magnetic field standard. These standards (summarized in Table 4-6) are all based on field strengths within or at the edge of transmission line rights-of-way. The widths of these rights-of-way vary greatly, according to the voltage of the lines and the regulatory requirements of each state. These standards are not based on health-related information.

Table 4-6
State Regulations that Limit Field Strengths on Transmission Line Rights-of-Way

Electric Field Limits	
Montana	1 kV/m at edge of ROW in residential areas
Minnesota	8 kV/m maximum in ROW
New Jersey	3 kV/m at edge of ROW
New York	1.6 kV/m at edge of ROW
North Dakota	9 kV/m maximum in ROW
Oregon	9 kV/m maximum in ROW
Florida	10 kV/m maximum for 500 kV lines in ROW 2 kV/m maximum for 500 kV lines at edge of ROW 8 kV/m maximum for 230 kV and smaller lines in ROW 3 kV/m maximum for 230 kV and smaller lines at edge of ROW
Magnetic Field Limits	
New York	200 mG at edge of ROW
Florida	200 mG for 500 kV lines at edge of ROW 250 mG for double-circuit 500 kV lines at edge of ROW 150 mG for 230 kV and smaller lines at edge of ROW

ROW = Right-of-way.

The International Nonionizing Radiation Committee of the International Radiation Protection Association published "Interim Guidelines on Limits of Exposure to 50/60-Hz Electric and Magnetic Fields" in the January 1990 issue of *Health Physics*. In a May 12, 1993 press release, the organization confirmed the guidelines after considering new evidence in laboratory and epidemiological studies of both occupational and general populations. Its conclusion is that the data related to cancer do not provide a basis for health risk assessment of human exposure to power frequency fields. The guidelines relating to the general public are summarized in Table 4-7.

Table 4-7 Interim Guidelines on Limits of Exposure to 50/60-Hz Electric and Magnetic Fields		
General Public Exposure Characteristics	Electric Field Strength (kV/m)	Magnetic Flux Density (mG)
Up to 24 hours/day	5	1,000
Few hours/day	10	10,000

A number of states and counties are addressing public policy strategies for EMF through their public utility commissions, special task forces, legislatures or other Hawaii agencies. A number of states have adopted the strategy of "prudent avoidance" (e.g., Hawaii, California, Wisconsin, Colorado) whereby public exposure to EMF is avoided where practical. Other states have adopted field strength standards, as shown in Table 4-6 that are largely based on existing field levels. In Sweden, The National Electric Safety Board, which is responsible for public EMF policy, is considering the establishment of EMF regulations for new electric facilities near schools, houses, and day care facilities. Currently, there are no regulations in Sweden for electric and magnetic fields from power lines.

The current efforts to address EMF are in response to public fears about the possible adverse health effects from magnetic fields. Some epidemiologic studies (discussed in Chapter 5) have indicated an association between estimated magnetic fields and childhood leukemia. However, when all studies are evaluated, the findings are inconsistent and inconclusive concerning EMF and childhood or adult cancers. This lack of a firm scientific basis to establish a connection between EMF and health effects in spite of public fear over EMF results in a variety of public policy responses to EMF.

4.3.5 Other Transmission Line Electrical Factors

4.3.5.1 Corona

Corona is the physical manifestation of energy loss and can transform energy into very small amounts of light, sound, radio noise, chemical reaction, and heat. Because energy loss is not economical, corona has been studied since the early part of this century. Consequently, it is well understood by engineers and steps to minimize it are major factors in line design. The

line designer can control corona with good design practices, and it is usually not a problem for lines rated at 230-kV and lower.

4.3.5.2 *Audible Noise*

During corona activity, transmission lines (mainly 345-kV and above) generate a small amount of sound energy. This audible noise from the line can barely be heard in fair weather conditions on the higher-voltage lines and usually not at all on lines at 138-kV. During foul weather, water drops collect on the conductor and increase corona activity so that a crackling or humming sound may be heard near the line. This noise is caused by small electrical discharges from the water drops. Audible noise decreases rapidly with distance from the line.

4.3.5.3 *Radio and Television Interference*

Overhead transmission lines do not, as a general rule, interfere with normal radio or television reception. As described above, corona discharges can sometimes generate unwanted electrical signals. There are two potential sources of interference: corona and gap discharges. Corona may affect AM radios; gap discharge can affect television and radio reception. Corona activity is minimized by proper line design, and therefore is almost never a source of interference, especially on lines smaller than 230-kV. HECO proposed design of the 138-kV lines so that television interference levels will be extremely low (lower than on many previous 138-kV lines on the mainland, where television interference has not been a problem).

Gap discharges are a very different problem. They are caused by electrical discharges between broken or poorly fitting hardware (e.g., insulators, clamps, and brackets). Hardware is designed and installed to be problem-free, but gunshot damage, wind motion, or corrosion damage sometimes can create a gap discharge condition. When this condition develops, intermittent gaps at connection points between hardware items allow small electrical discharges to occur between the gaps. This phenomenon is not limited to transmission lines and can often be found on distribution lines. The discharges act as small transmitters at frequencies that may be received on some radio and television receivers. Gap discharge sources can be located by HECO engineers and repaired.

4.3.5.4 *Ozone*

Ozone is another possible byproduct of higher-voltage transmission lines that has raised some concern. Ozone (O_3) can be formed from charged air molecules through the combination of three oxygen atoms. Ambient ozone levels in rural areas are typically around 10 to 30 parts per billion (ppb) at night and may peak during the day at around 100 ppb. In urban areas, concentrations greater than 100 ppb are common. Cities like Los Angeles may peak at 500 ppb. The National Ambient Air Quality Standard for oxidants (of which ozone is usually 90 to 95 percent) is 120 ppb, not to be exceeded as a peak concentration on more than 1 day a year.

A theoretical worst-case ozone level increase in the vicinity of a transmission line would occur in the following conditions: heavy rains, light winds blowing exactly parallel to the line, and 10 or more continuous hours of these conditions.

4.3.5.5 *Cardiac Pacemakers*

One concern associated with the 345-kV and larger lines has been the possibility of interference with cardiac pacemakers. There are two general types of pacemakers: asynchronous and synchronous. The asynchronous pacemaker pulses at a predetermined rate. It is practically immune to interference because it has no sensing circuitry and is not exceptionally complex. The synchronous pacemaker pulses only when its sensing circuitry determines pacing is necessary. Interference may result from the transmission line electric field causing a spurious signal on the pacemaker's sensing circuitry. However, when these pacemakers detect a spurious signal, such as a 60-hertz signal, they are programmed to revert to an asynchronous or fixed pacing mode of operation. Cardiovascular specialists do not consider prolonged asynchronous pacing to be a problem. Some pacemakers are designed to operate that way. Periods of operation in this mode are commonly induced by cardiologists to check on pacemaker performance. Therefore, although a transmission line electric field may interfere with the normal operation of some pacemakers, the result of the interference is both not harmful and of short duration.

4.3.5.6 *Induced Current*

When transmission lines parallel other types of conductors, such as oil and gas pipelines or metal fences, an electric current in these objects can be induced. Induced electrical currents in these and other facilities can be mitigated by proper design measures.

4.4 Biological Resources

4.4.1 Vegetation

The Waipahu and Pearl City sections are mostly urbanized with few undeveloped or agricultural lands. Biological surveys conducted in the study area reveal that plants, animals, and their habitats have been greatly disturbed by human activities over a long period of time (Figures 4-4 and 4-5). Ornamental and landscaped species characterize the vegetation around residential and business areas, while less maintained areas along roadsides and the H-1 freeway support an assortment of weedy ruderal species. A koa-hao (Leucaena leucocephala) scrub community is found in less disturbed areas, primarily along drainageways, on steeper slopes, and along the OR&L right-of-way, H-1 freeway, and other transportation corridors. The limited vegetation that exists in the developed areas is composed almost exclusively of introduced species; no native vegetation or significant natural plant communities remain.

**AREA SUBJECT TO
NAVY EASEMENT —**

Limits of Vegetation Mapping

Aug
Ähre
Sch

**OAHU SUGAR
COMPANY**

Hongwanji L Orange
Mission Sch Park

S. 100

Qa

TKI

Bar

Q'a

ATK

Tkb

Honowai Sch

WA/PAT

Qa

Waipahu

卷之三

Sug
Kāli

Qa

Ca

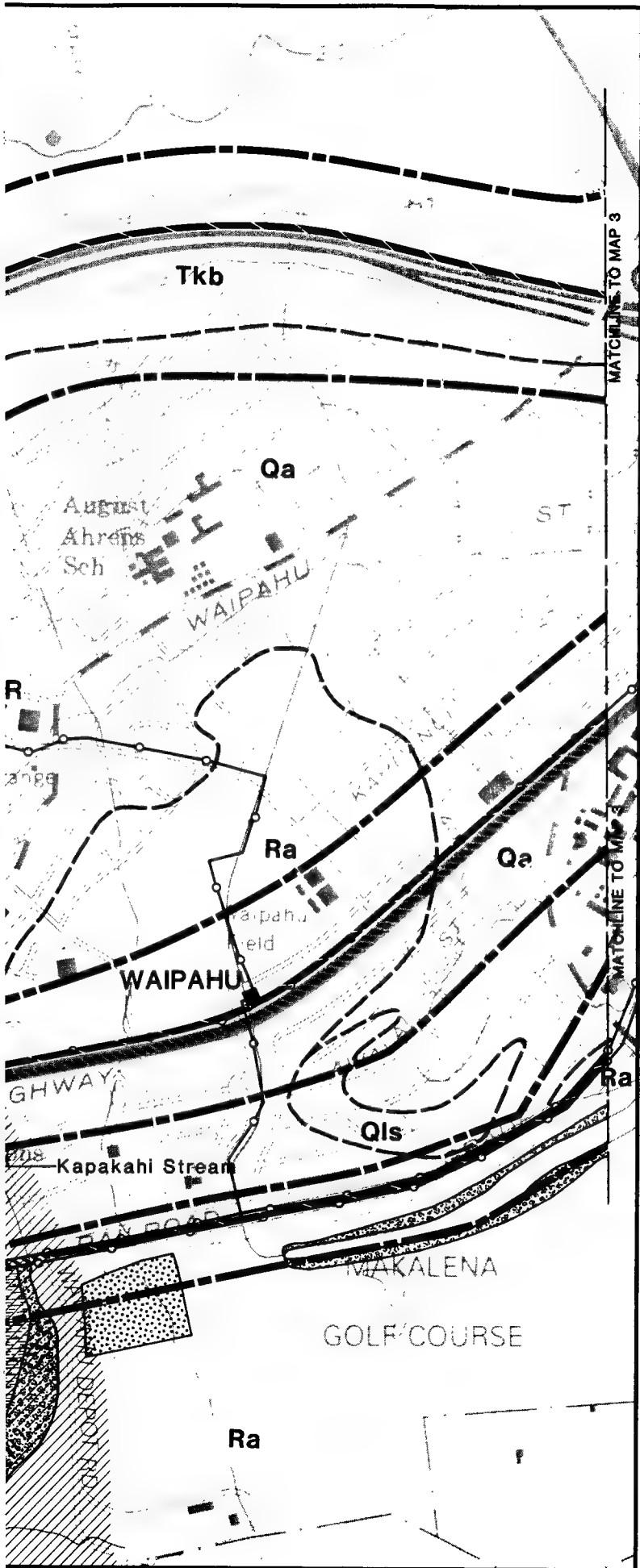
~~EARING AD A
ATCHLINE~~

HOA EAE

R

EO

Waikeler Stream



ALIGNMENT DATA MAP GEOPHYSICAL AND BIOLOGICAL

H-1 F.H. OR & L	Double-Circuit Overhead Line
.....	Double-Circuit Underground Line
—	Single-Circuit Overhead Line
—	Single-Circuit Underground Line

Corridor Boundary
Existing 138 kV Line
Existing 46 kV Line
Substation

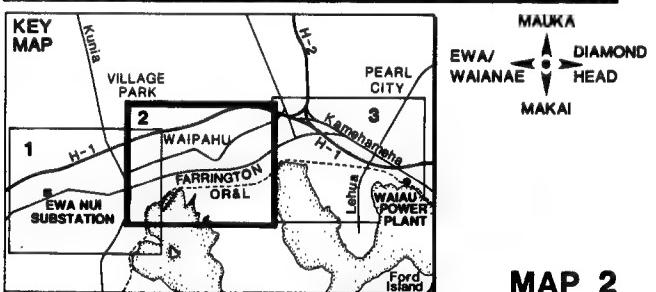
GEOPHYSICAL

- Tkb Koolau Basalt
- Qa Older Alluvium
- Ra Recent Alluvium
- Qls Coral-Algal Deposits
- Stream
- Open-Lined Channel
- Spring
- Flood Prone Area*

BIOLOGICAL

- Cane Fields
- Urban/Developed Lands
- FOREST**
- Kiawe Forest
- Koa-haoe Scrub
- Mixed Scrub
- WETLANDS**
- Mangrove Swamp
- Non-Woody Wetlands
- Cultivated Wetlands

*Subject to inundation by 100-year flood



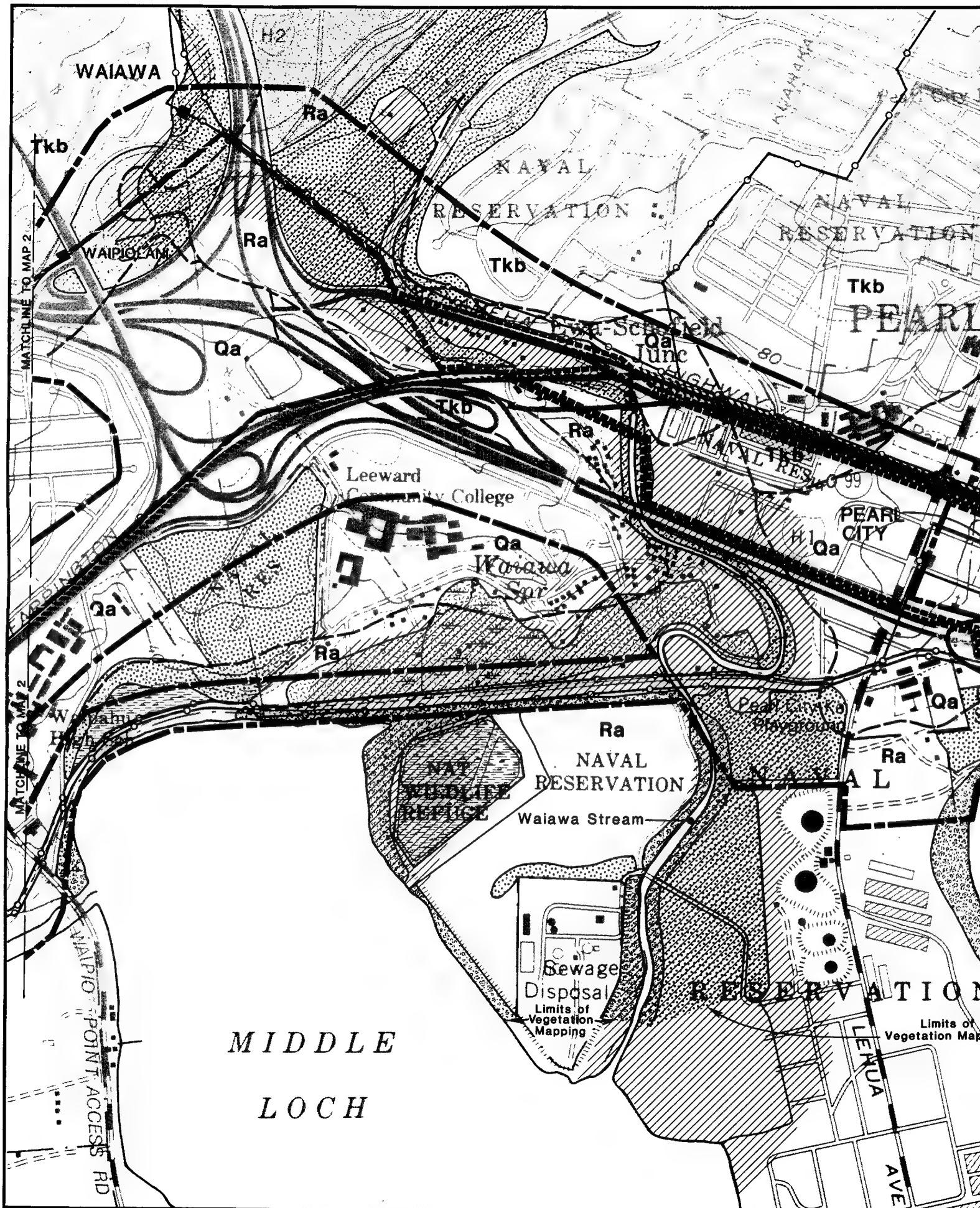
MAP 2

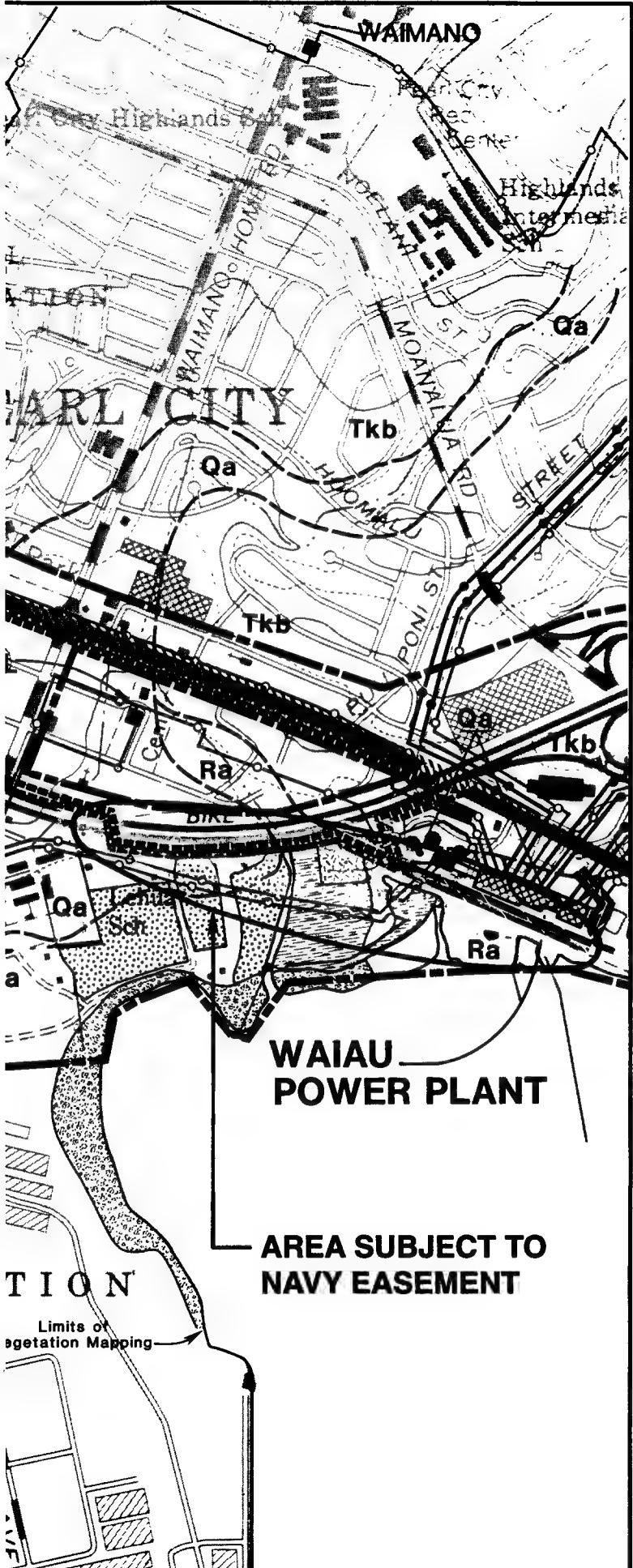
SCALE
0 500 1000 FEET
0 1/8 1/4 MILE
NORTH
WEST EAST
SOUTH

FIGURE 4-4

Waiau – Campbell Industrial Park Transmission Line Project
Hawaiian Electric Company

CH2MHILL





ALIGNMENT DATA MAP GEOPHYSICAL AND BIOLOGICAL

H-1 F.H. OR & L	Double-Circuit Overhead Line
Double-Circuit Underground Line	
Single-Circuit Overhead Line	
Single-Circuit Underground Line	
Corridor Boundary	
Existing 138 KV Line	
Existing 46 KV Line	
Substation	

GEOPHYSICAL

- Tkb Koolau Basalt
- Qa Older Alluvium
- Ra Recent Alluvium
- Qls Coral-Algal Deposits
- Stream
- Open-Lined Channel
- Spring
- Flood Prone Area*

BIOLOGICAL

- Cane Fields
- Urban/Developed Lands

FOREST

- Kiawe Forest
- Koa-Haole Scrub
- Mixed Scrub

WETLANDS

- Mangrove Swamp
- Non-Woody Wetlands
- Cultivated Wetlands

*Subject to inundation by 100-year flood

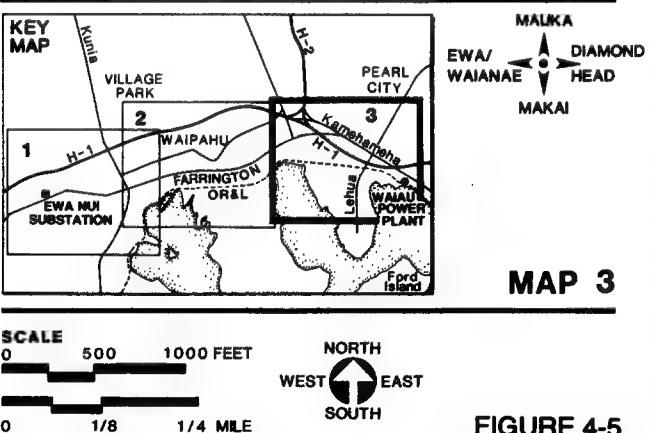


FIGURE 4-5

Waiau – Campbell Industrial Park Transmission Line Project
Hawaiian Electric Company

The most significant and least disturbed vegetation within the overall study area occurs in the wetlands along the shores of the East Loch of Pearl Harbor. The nonwoody wetlands community is composed of various members of the sedge family (Cyperaceae), cattails (*Typha latifolia*), and pickleweed (*Batis maritima*). Nonwoody wetlands occur in an area adjacent to the Waiau Power Plant. This area provides important habitat for four endangered species of waterfowl (see Wildlife section, below). A Special Management Area designation protects nonwoody wetland communities as valuable coastal resources. The SMA includes lands inland and makai of the OR&L right-of-way along Pearl Harbor and that portion of all overhead alternatives that connect to the Waiau Power Plant. The limits of the wetlands involved were determined through consultations with the U.S. Army Corps of Engineers during the preparation of the State EIS for the Waiau-CIP Project, Part 2. In addition, both HECO and USCOE staff walked the proposed route to determine the extent of wetlands. No wetlands were encountered along the proposed route (see letter, Appendix A).

Other, less significant cultivated wetlands occur in a small area inside the Waiau Power Plant SMA. Cultivated wetland crops include watercress (*Nasturtium microphyllum*), taro (*Colocasia esculenta*), and ung-choi (*Ipomoea aquatica*).

No plant species identified in the study area have been listed by the U.S. Fish and Wildlife Service (USFWS) as threatened or endangered. Similarly, no special-status plant species or sensitive plant communities have been identified by the State of Hawaii.

4.4.2 Wildlife

The wildlife occurring in the urbanized areas consist primarily of introduced species. Of the few undeveloped lands remaining, only the wetlands provide habitat for any significant populations of native wildlife. The Waiawa Unit of the Pearl Harbor National Wildlife Refuge, located 1.5 miles west of Waiau Power Plant, is designated by the USFWS as an "Essential Habitat" for the survival of four endemic species of waterfowl, all of which are on the federal and state endangered lists. These species are the Black-necked (Hawaiian) Stilt or Ae'o (*Himantopus mexicanus knudseni*), the Common (Hawaiian) Moorhen or 'Alae-'Ula (*Gallinula chloropus sandvicensis*), the American (Hawaiian) Coot or 'Alae-Ke'oke'o (*Fulica americana alai*), and the Hawaiian Duck or Koloa (*Anas wyvilliana*). Other wetlands, including those at power plant as well as riparian areas, irrigation ditches, and ponds, are also used by these species, but to a lesser degree. A bird that occurs sporadically throughout the project area in undeveloped and agricultural lands is the Hawaiian Owl (or Pueo). It is on the state endangered list for the Island of Oahu only.

The mouths of the Waikeli, Kapakahi, and Waiawa Streams and Pearl Harbor generally are habitats for the nehu fish (*Stolephorus purpureus*), a commercial bait fish used in the local tuna fishery. Important food fish that live in the Pearl Harbor estuary include the awa (milk fish), mullet species, and various species of ulua/papio (jacks). Native gobi species migrate through these streams throughout their life cycle. Sediment loading impacts these streams during the rainy season (John Naughton, personal communication, 1992).

No endangered, threatened, or sensitive marine or freshwater fish species are known to exist in the project area.

4.5 Water Resources

4.5.1 Surface Waters

There are no lakes or rivers in the study area. Several ponds, marshes, swamps, and salt flats occur in the Waipahu and Pearl City sections along the areas bordering Pearl Harbor. The Waiawa, Kapakahi, and Waikele Streams are perennial in their lower reaches near Pearl Harbor. Many intermittent stream channels drain the slopes of the Waianae and Koolau Mountains, as indicated in Figure 4-6. The Waimano Stream, channelized in its northern reaches, is not channelized in the vicinity of the Waiau Power Plant. The proposed Waiau-CIP, Part 2, alignment will span Waimano Stream near the makai edge of the H-1 freeway where the stream separates Navy and HECO properties.

No lands subject to the proposed action are in a 100-year floodplain.

4.5.2 Groundwater

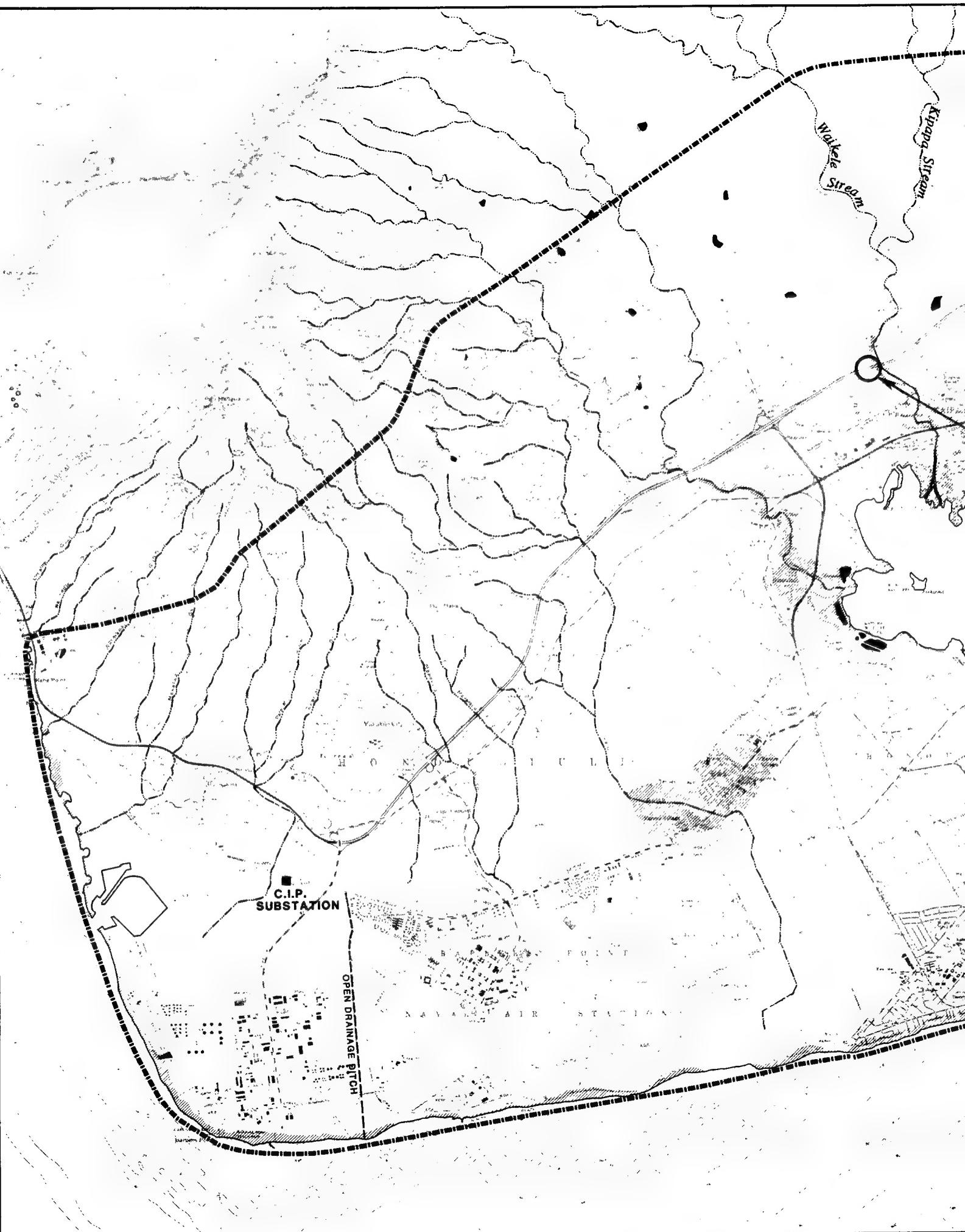
The entire study area displays similar groundwater characteristics. In general, the groundwater lies within the basalt aquifer below an impervious layer of caprock, which prevents the groundwater from rising to the surface and holds it under artesian pressure. The groundwater level throughout the study area is typically several feet above sea level. Generally, there is a good chance of encountering artesian groundwater at any location where pole foundations encounter Koolau basalt at an elevation of less than 20 feet. Where fractures exist in the caprock, groundwater may leak out as springs.

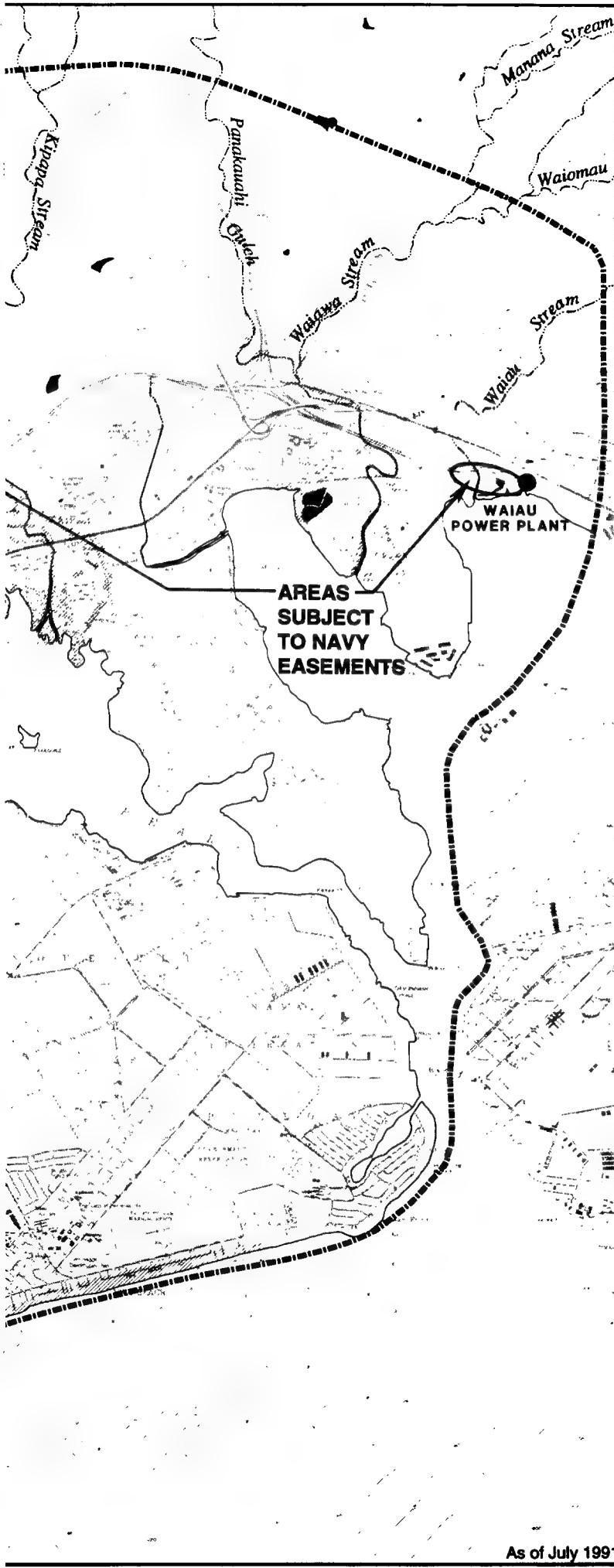
4.6 Earth Resources

4.6.1 Geology

The study area lies approximately at sea level and is gentle and rolling in its topography; it has only a few sharp changes in relief. Seismic and related ground movement activities are rare or unusual in the study area. U.S. Coast and Geodetic Survey data show that all of Oahu is in Zone 2 of the seismic risk maps (the next-to-lowest risk category). No faults have been identified in the study area. Areas of steep slopes (greater than 20 percent) are located primarily in the slopes above the Waikele and Waiawa Streams. These slopes are very unstable and subject to landslides (Figure 4-7).

Four geologic formations exist in the study area: Koolau basalt (TKb), older alluvium (Qa), coral-algal deposits (OIS), and recent alluvium (Ra) (Figures 4-5 and 4-6). Koolau basalt, the oldest of the formations, is the aquifer material of the Pearl Harbor Artesian Basin. Older alluvium, the second-oldest formation, frequently shows a moderate to high shrink/swell potential. The Koolau basalt, older alluvium, and coral-algal deposits are the most suitable of the four formations for standard drilled pier foundations. Recent alluvium formations have moderate to fair suitability for foundation support and pile-type foundations may be necessary in some locations.





WATER RESOURCES

- Study Area Boundary
- Flood Prone Areas (Subject to inundation by-100 year flood)
- Ponds
- Perennial Streams
- Intermittent Steams

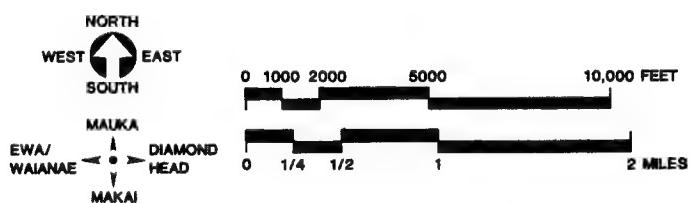
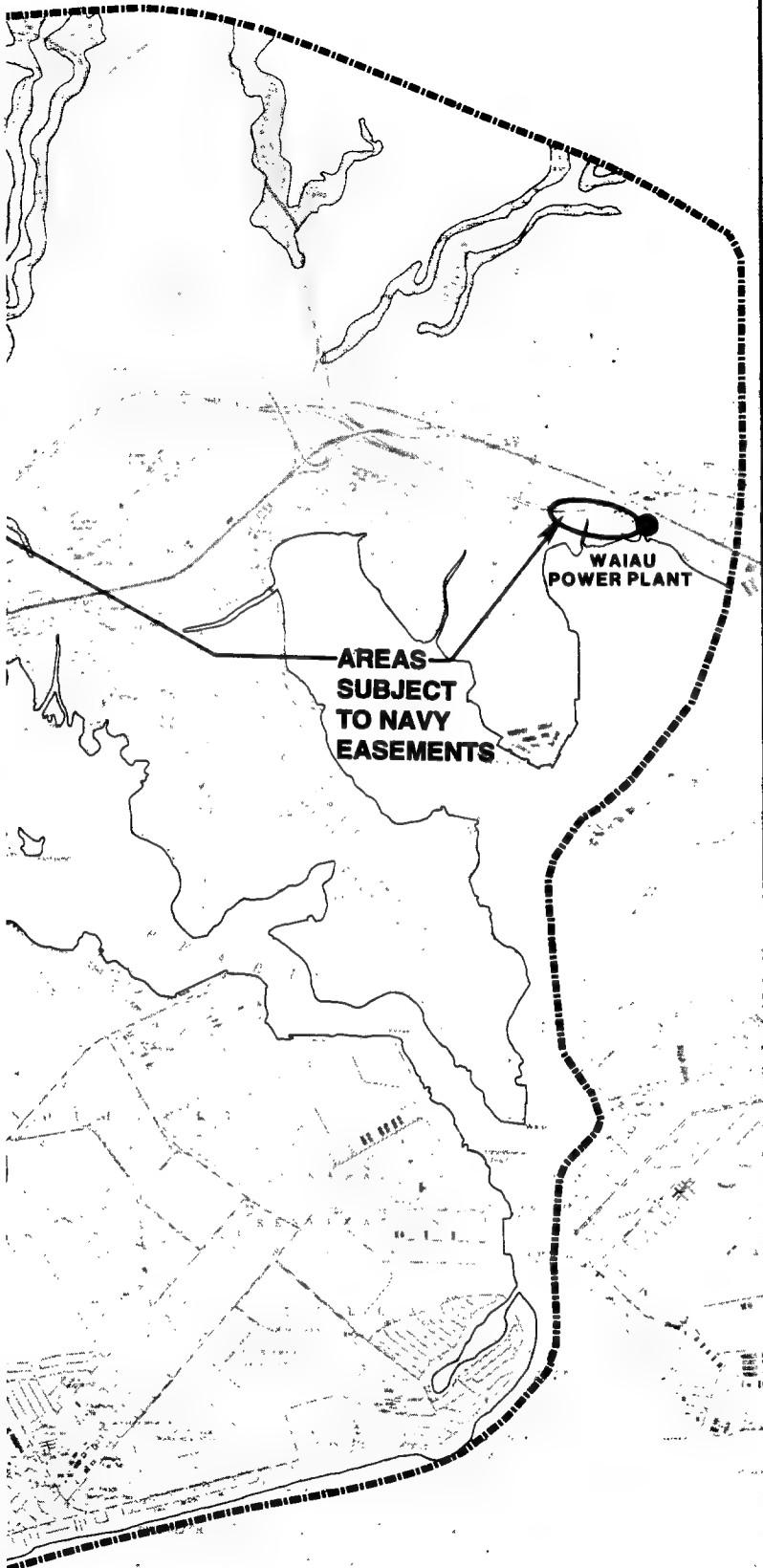


FIGURE 4-6

Waiau –
Campbell Industrial Park
Transmission Line Project
Hawaiian Electric Company





SLOPE

- Study Area Boundary
- Slopes greater than 20 percent

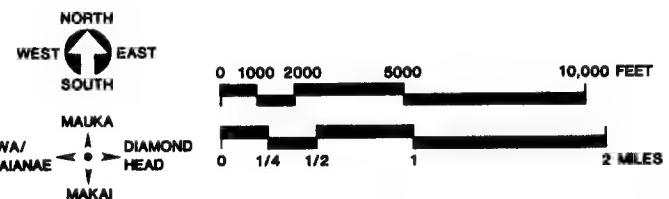


FIGURE 4-7

Waiau –
Campbell Industrial Park
Transmission Line Project
Hawaiian Electric Company

4.6.2 Soils

Older alluvium and/or recent alluvium deposits make up the majority of the soils in the alignment. Relatively impermeable alluvial and lagoonal deposits make up the caprock, which overlies the basalt aquifer. Older alluvium deposits consist mainly of very stiff to hard clayey silts that were deposited by stream action. Recent alluvium consists primarily of very soft to medium stiff clayey silt, often submerged underwater. These wet soils are located primarily in the low-lying areas near Pearl Harbor (Figure 4-8). The portion of the proposed action near the Waiau Power Plant is believed to be underlain by thick deposits of very soft soils. These soils are generally considered to be poorly to very poorly suited for use as support for foundation loads. Soils with high shrink-swell potential (which are generally also recent alluvium soils) are located between Waiawa Stream and the Waiau Power Plant.

4.7 Transportation and Traffic

Two major roadways transect the study area: the H-1 freeway and Kamehameha Highway. The project area (subject to Navy easements) is adjacent to H-1. Navy easements are not required along Kamehameha Highway.

The H-1 freeway is a major arterial that begins at Ewa and goes east through the study area to Waialae. Through the study area, H-1 has been built to U.S. Department of Transportation Interstate Highway standards, with exclusive rights-of-way and controlled accesses and exits. The section of the freeway east of the Waiawa Interchange through Pearl City is elevated. Average daily traffic for the 27-mile H-1 freeway was 113,323 in 1991. About 7 miles of H-1 pass through the project area from the Ewa Nui Substation to the Waiau Power Plant. Traffic volumes for the H-1 freeway within the study area are shown in Table 4-8.

**Table 4-8
Peak and 24-Hour Traffic Volumes, H-1 Freeway—1989**

	West of Kunia Interchange	Kunia Interchange to Waiawa Interchange (West End)	Waiawa Interchange (East End) to Waiau Interchange
24-hour volume	57,520	86,733	172,961
A.M. peak 1-hour			
Eastbound	4,889	6,939	14,702
Westbound	2,689	3,816	11,026
P.M. peak 1-hour			
Eastbound	2,200	3,123	3,676
Westbound			
P.M. peak 1-hour			
Eastbound	4,889	6,939	13,837
Westbound	2,444	3,123	5,535
	2,445	3,816	8,302

Source: State of Hawaii Department of Transportation, Traffic Summary, Island of Oahu, 1991.

4.8 Utilities, Pipelines, and Hazardous Waste

The study area contains a network of linear utility rights-of-way that have been used to develop siting alternatives for the proposed transmission lines. Electric utilities and oil and gas pipelines that exist adjacent to and crossing the alternative alignment are shown in Figure 4-9, and are summarized as follows:

- 46-kV overhead lines along H-1, Kamehameha Highway, and Kunia Road
- Oil and gas pipelines and 46-kV overhead lines in the State of Hawaii Energy Corridor and along the length of the OR&L right-of-way

The only existing 138-kV transmission lines in the study area run along the inland side of Kamehameha Highway for approximately 1,000 feet near the Waiau Power Plant.

The alternatives under consideration have followed these existing linear facilities as much as possible to avoid disruptions that new transmission lines might create in areas where no lines now exist. Oil and gas pipelines and electric utility, water, sewer, and communication ductwork facilities adjacent to the alternative alignments are described below, along with associated siting constraints.

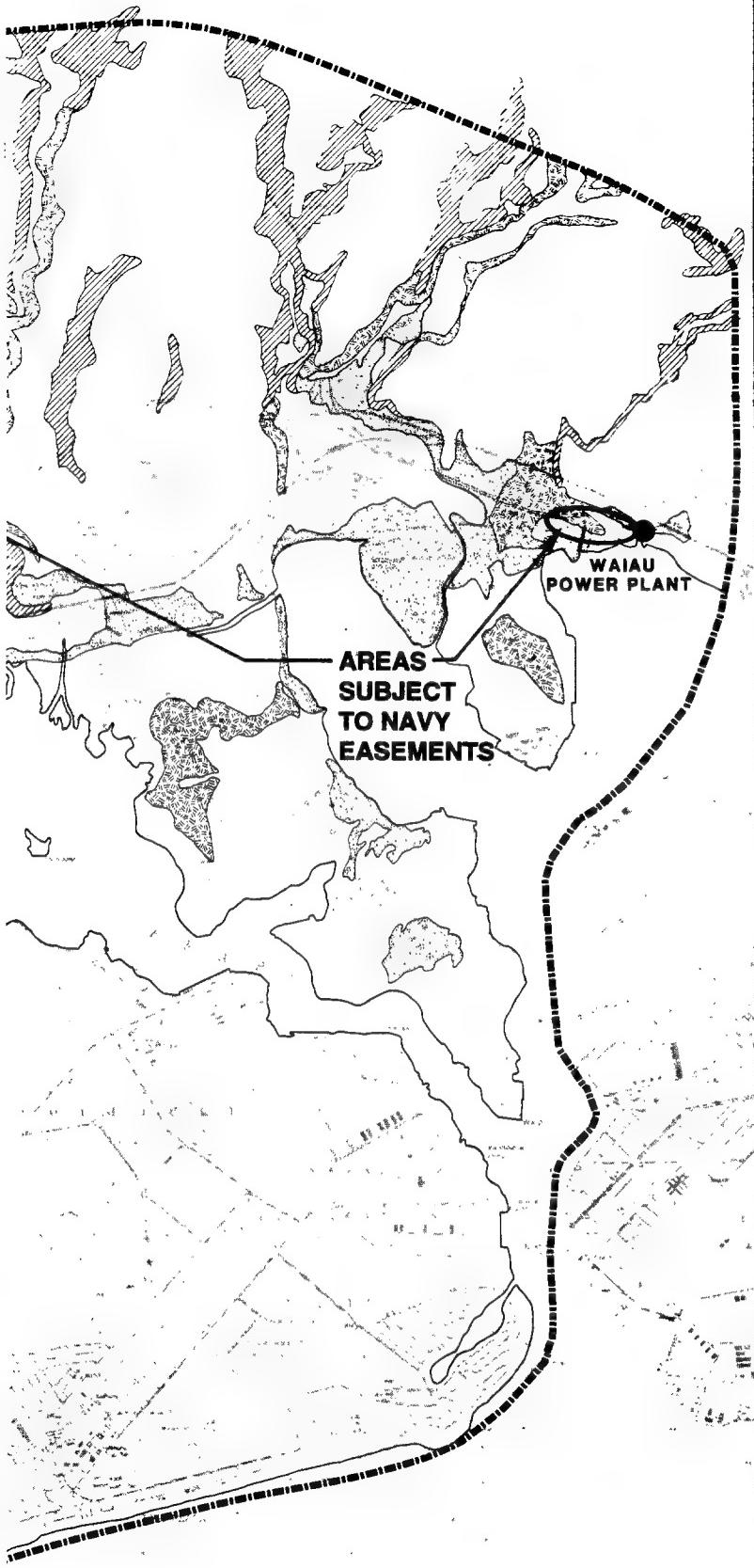
4.8.1 Electric Utilities

There are sections of 12-kV, 46-kV, and 138-kV transmission lines in the study area, as shown in Figure 4-9. Existing 46-kV lines provide overbuild opportunities where new 138-kV lines and the 46-kV lines can occupy the same pole and right-of-way; 46-kV lines along the Energy Corridor and H-1 freeway have this capability. An important criterion in siting 138-kV transmission lines, however, is to provide adequate separation from other 138-kV lines to reduce the possibility that a single emergency (e.g., fire, aircraft accident, or windstorm) would simultaneously damage two or more of the principal transmission lines. This is essential for this project because increased system reliability is a primary goal. Therefore, underbuilding of existing 138-kV lines is not proposed.

4.8.2 Oil and Gas Pipelines

The State Energy Corridor contains most of the oil and gas pipelines in the study area. The Energy Corridor, established to provide for the transportation of energy sources in the state, begins at the refinery in the Campbell Industrial Park and terminates in central Honolulu. For part of its length the Energy Corridor parallels H-1, crosses Lehua Avenue at Lehua Elementary School, then follows a path makai of H-1 to Waimano Stream. There it parallels the stream to its mouth, then continues past the Waiau Power Plant along the shoreline to central Honolulu. No underground utilities are in the portion of the Energy Corridor by Waimano Stream.





SOILS

- Study Area Boundary
- Soils with High Erosion Potential
- Wet Soils (Peat/Muck Substratum)
- Soils with High Shrink-Swell Potential

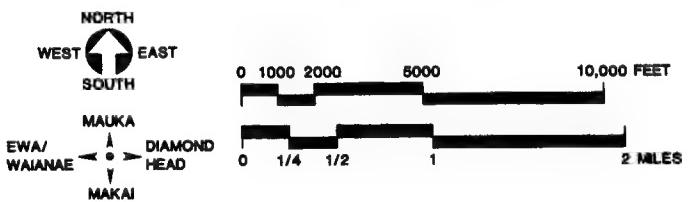
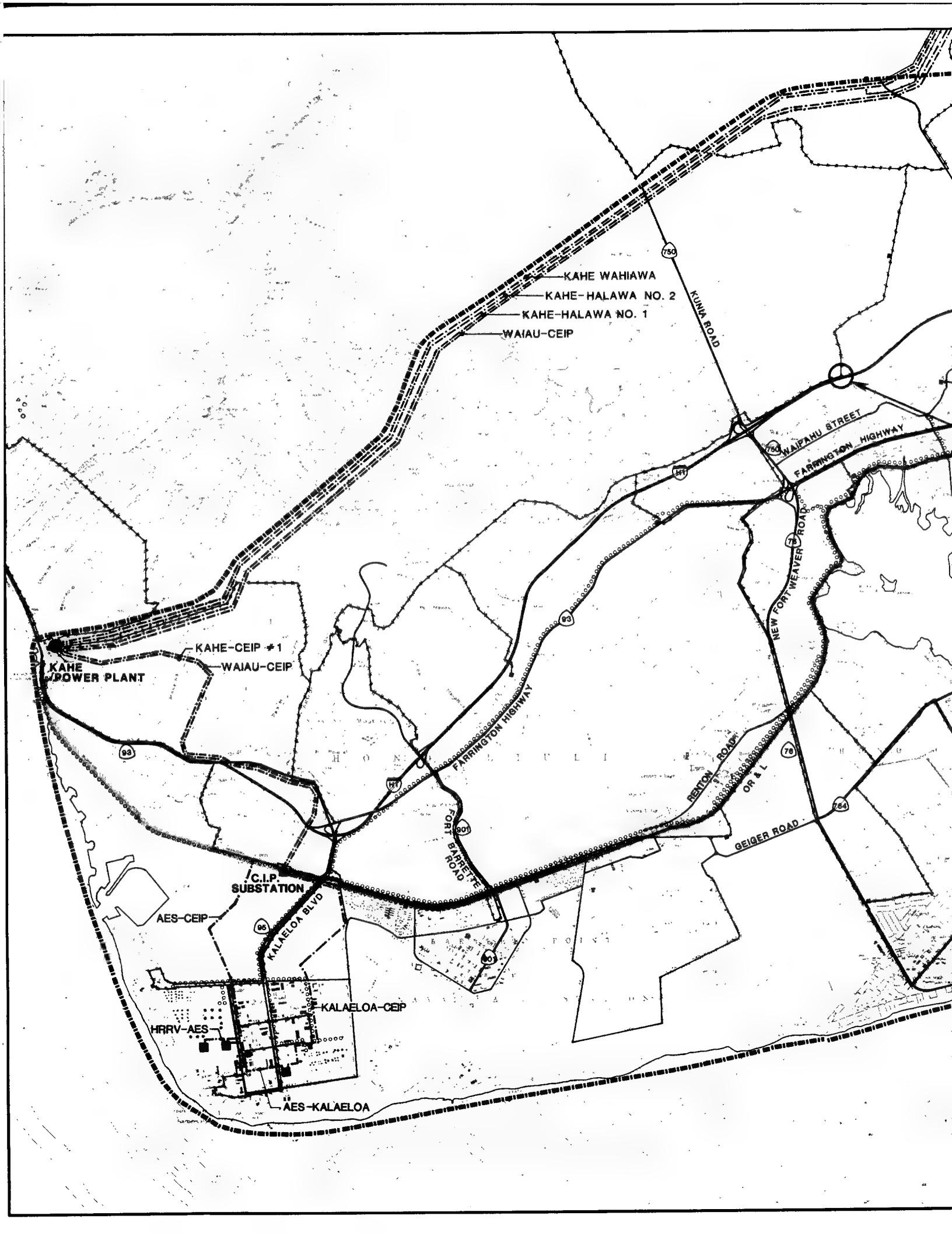
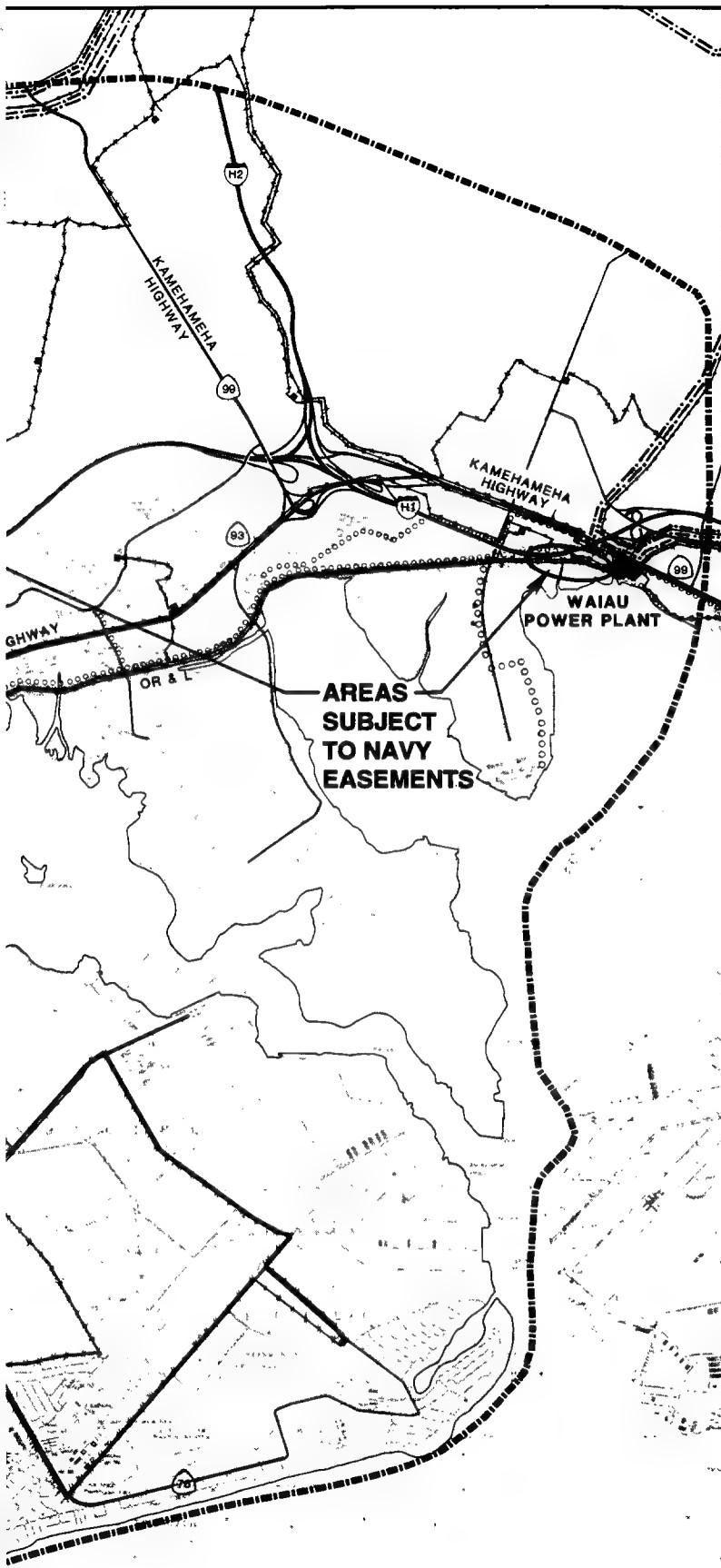


FIGURE 4-8

Waiau –
Campbell Industrial Park
Transmission Line Project
Hawaiian Electric Company





UTILITY AND TRANSPORTATION SYSTEMS

- Study Area Boundary
- Power Plant
- Substation
- 138kV Lines
- 46kV Lines
- H1 Interstate Routes
- 99 State Routes
- Major Local Roads
- Oahu Railway and Land Company (O R & L) Right-of-Way
- Oil/Gas Pipelines

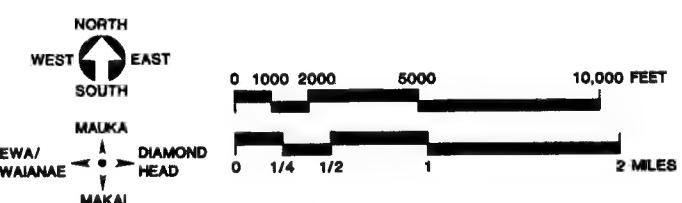


FIGURE 4-9

Waiau –
Campbell Industrial Park
Transmission Line Project
Hawaiian Electric Company

The U.S. Navy maintains underground fuel lines in the study area. The lines run along Lehua Avenue from Victor Pier on the Pearl City Peninsula northward to the OR&L right-of-way, where they turn eastward into the right-of-way. The lines follow the abandoned OR&L right-of-way as it passes to the north side of H-1 freeway by Lehua Elementary School, then back to the south side of the freeway over to the Waiau Power Plant where it then joins the bike path passing through the power plant. The fuel lines terminate at the Moanalua tank farm.

Chevron USA, Inc., maintains two 8-inch-diameter lines (one black oil and one white oil) and a 4-inch-diameter, heater oil line within the study area. The Chevron lines run along the makai side of the Energy Corridor, along the shoreline of Pearl Harbor, and across the top of the Waipio Peninsula. The lines then continue through the Waiau Power Plant to central Honolulu. There have been documented occurrences of soil contamination by fuel oil from the Chevron lines along this right-of-way.

4.8.3 Water, Sewer, and Communication Ductwork

There are numerous water, sanitary/storm sewer, and communication ductwork lines in the study area. The City and County of Honolulu owns two sanitary sewer force mains along the energy corridor from Waimano Home Road to Kapakahi Stream, ranging from 30 to 48 inches in diameter. The Navy owns a single 30-inch-diameter water main serving the Pearl City Peninsula, which crosses the Energy Corridor near Waimano Home Road. Current mapping data are insufficient to accurately locate these lines.

4.9 Air Quality

Air quality standards that apply to the project area are the National Ambient Air Quality Standards (EPA, 40 Code of Federal Regulations [CFR] 50, as amended), and those contained in the Hawaii Administrative Rules Title 11, Chapter 59. Air quality on Oahu is monitored by the Department of Health (DOH), Division of Pollution Investigation and Enforcement.

Each pollutant listed has the potential to cause some form of adverse human health or welfare effect, if present in high enough concentrations. The national standards are set at a point below which known adverse effects are not expected to occur. The state standards are more stringent than the comparable national standards. The state standards have been set lower to include an extra margin of safety designed to protect especially sensitive individuals and to allow for the possibility that unexpected undesirable effects could result from long-term exposures to currently allowable concentrations of these pollutants.

The DOH has an air monitoring station located on the Pearl City Peninsula at 860 4th Street, Pearl City. The station predominantly monitors traffic-related pollution. A review of the data collected from that station indicates that levels of all regulated pollutants are below State and Federal standards. The project area lies within a U.S. Environmental Protection Agency (EPA) designated attainment area.

4.10 Noise

The primary sources of noise in the study area are motor vehicles on streets and highways. The highest noise levels are generally heard adjacent to at-grade sections of high traffic volume roads, or near high volume freeway interchanges. These conditions exist along the entire length of the overall preferred alignment. The H-1/H-2 Interchange is also an area with relatively high ambient noise levels. The only existing land use near the preferred alignment subject to Navy easements that is sensitive to noise is Lehua Elementary School.

4.11 Cultural and Historic Resources

4.11.1 National Register Historic District and National Historic Landmark

In 1964, the Pearl Harbor Naval Base was designated a National Historic Landmark by the Secretary of the Interior because of its crucial role in the nation's defense, particularly for its role in World War II as the site of the air attack on December 7, 1941. With the establishment of the National Register of Historic Places in 1966, Pearl Harbor was also designated a Historic District.

The National Register designation provides for the protection of all facilities on the Naval base, including archeological structures, fish ponds, and subsurface materials. Any action taken within the boundary of the Pearl Harbor Naval Base must comply with the Pearl Harbor Historic Preservation Plan (Dept. of the Navy, 1978). Historic preservation guidelines were established in a Memorandum of Agreement drafted by the Advisory Council on Historic Preservation, the U.S. Navy, and the State Historic Preservation Office (1979).

The structures in the landmark are classified into three categories: (1) structures that make a major contribution to the historic character of the Naval complex and should be preserved where possible; (2) those that make a lesser contribution to the complex and need to be recorded if altered; and (3) those that make no contribution to the historic character of the landmark. Any activities that affect structures in the first two categories must be reviewed and mitigative actions may be required in accordance with the Memorandum of Agreement and the Pearl Harbor Historic Preservation Plan.

The Waiau-CIP, Part 2 alignment is adjacent to the boundary of the Pearl Harbor National Register Historic District and National Historic Landmark along shoreline areas of the Waiau Power Plant property.

4.11.2 Cultural Resources Potential

4.11.2.1 Methodology

The cultural resources potential of the project area was surveyed early in the siting process (see Routing Report, February 1992). The survey was completed by an archeologist working in cooperation with the state archeologist and the state historian. In addition, a predictive model was developed to assess the potential for the location of archeological sites in the unsurveyed sections of the study area. Areas were determined to have high, medium, or low potential for containing cultural resources based on a review of the available ethnographic and ethnohistoric data and on comparisons with environmentally similar areas of Hawaii that had been surveyed for cultural resources, as shown in Figure 4-10.

- Unsurveyed area with high potential for cultural resource recovery

This category includes areas where there is a relatively high probability that archeological remains could be found if subsurface investigations were conducted. These areas were determined by the following criteria: (1) similar environmental settings in Hawaii have contained a high number of sites and other types of archeological data; (2) known ethnographic and ethnohistoric data support the potential for locating subsurface archeological remains; and (3) shorelines and river or streambeds often have a high frequency of archeological sites.

- Unsurveyed areas with medium potential for cultural resource recovery

This category includes unsurveyed areas that are similar to areas where surveys have resulted in a moderate to low frequency of archeological recovery.

- Unsurveyed areas with poor potential for cultural resource recovery

This category includes unsurveyed areas with a poor likelihood of archeological recovery.

4.11.2.2 Analysis

A total of 42 separate archeological reports were on file at the Hawaii Department of Land and Natural Resources for the Part 1 and Part 2 study area. Of these, 17 were either reports on surveyed land containing no sites or were assessment reports, research designs, etc. The remaining 25 reports are listed in Table 4-9. Figure 4-10 shows the location of the historic sites on file with the State of Hawaii for the study area.

Table 4-9
Historic Sites on File with State of Hawaii

Report No.	Description	National Register of Historic Places
1	Fragmentary walls and enclosures; historic material	No
2	Oneula, 107 recorded features	Yes
3	Oneula, 8 sites; platform paved areas, shelters, platforms	Yes
4	14 sites; shelters, kilns, shrines, midden, enclosures	No
5	58 sites	No
6	No data available	No
7	No data available	No
8	23 petroglyphs, Barbers Point	No
9	Wakamiya Inari Shrine	Yes
10	Tsoong Nyee Cook House	Yes
11	No data available	No
12	No data available	No
13	OR&L right-of-way	Yes
14	Pearl Harbor Naval Base	Yes
15	Barbers Point Archeological District	Yes
16	Oneula Archeological District	Yes
17	No data available	No
18	No data available	No
19	No data available	No
20	No data available	No
21	No data available	No
22	No data available	No
23	No data available	No
24	Beach midden site	State of Hawaii Registered Site Yes
25	Okiokiolepe Fishpond	Yes

4.11.2.3 Fishponds

At one time there were a number of historically significant fish ponds in the area. Most of these have been destroyed; however, none of the remaining ponds are near the proposed transmission line route alternatives.

The section of the proposed action near the Waiau Power Plant is located on unsurveyed land with a potential for cultural resource recovery. It should be noted that most of the proposed action is located on land that has been previously disturbed by road or building construction. Although the area in its undisturbed state may have had high or medium potential for cultural resource recovery, the likelihood of finding undisturbed resources has been considerably reduced by development.

AF
SU
TO
EA

IN

PEA

Proposed
Alignment

Hawaiian Railway
Society Museum

O R & L
RIGHT-OF-WAY

C.I.P.
SUBSTATION

BARBERS POINT
ARCHAEOLOGICAL
DISTRICT

ONE'ULA
ARCHAEOLOGICAL
DISTRICT

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50

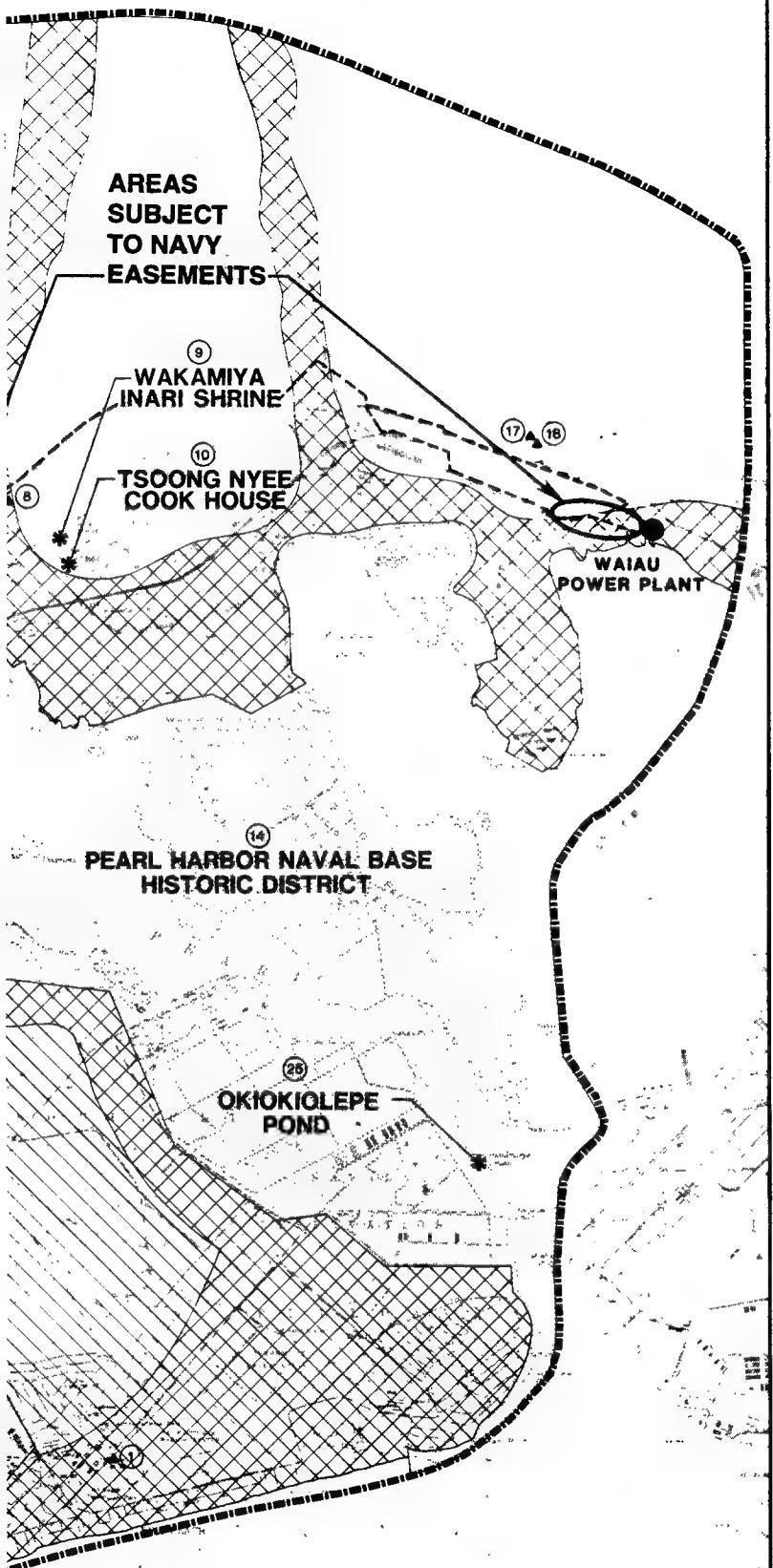
51

52

53

54

55



CULTURAL RESOURCES

- Study Area Boundary
- * National Register Sites
- National Register Districts (Historical & Archaeological)
- ▲ Recorded Archaeological or Historic Sites (Report Number on File - DLNR)
- Unsurveyed Areas with Good Cultural Resource Potential
- Unsurveyed Areas with Moderate Cultural Resource Potential
- Unsurveyed Areas with Poor Cultural Resource Potential
- (P) Petroglyphs
- Proposed Alignment

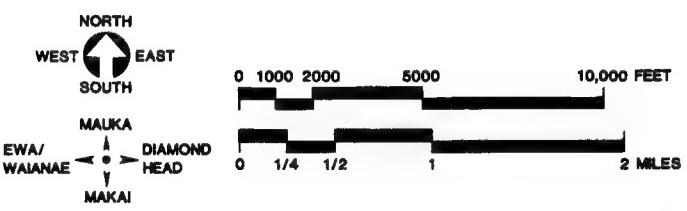


FIGURE 4-10

Waiau –
Campbell Industrial Park
Transmission Line Project
Hawaiian Electric Company

4.12 Public Services

Public services are located throughout the project area, as shown in Figures 4-1 and 4-2 (Existing and Proposed Land Use). General public services, such as police and fire, are available to the project area. The most significant issue regarding these services is their proximity to the proposed transmission line.

In the easterly segment of the project area is Lehua Elementary School, just makai of the OR&L right-of-way and west of the Waiau Power Plant. A bike path begins at the east side of Lehua Avenue inland of Lehua Elementary School and parallels the elevated section of the H-1 freeway in an easterly direction to a point just east of the Waimano Stream, then heads southeasterly through the Waiau Power Plant site and beyond.

Chapter 5

Environmental Consequences and Mitigation

This chapter presents an evaluation of the potential impacts of the proposed transmission line in the proposed action area (i.e., subject to Navy easements). Many of the potential impacts of the transmission lines were anticipated during the course of the routing study (February 1992 Routing Report; August 1992 State Final EIS), and potential impacts were mitigated by avoidance or by selecting an alignment that minimized impacts on the environment and surrounding land uses. Where impacts (either temporary or permanent) could not be entirely avoided during the siting process, mitigation measures have been identified.

For purposes of analysis, the State Final EIS for the Waiau-CIP, Part 2, Project divided the overall project area into three sections: Ewa, Waipahu, and Pearl City. Portions of the overall project area subject to Navy easements are located in the Waipahu and Pearl City sections of the preferred alignment. This chapter describes the potential impacts of the proposed project within the Waipahu and Pearl City sections of the preferred alignment.

5.1 Land Use

5.1.1 Impacts

5.1.1.1 Waipahu Section

The proposed Waiau-CIP, Part 2 alignment will cross over Military Road on the east edge of the existing Village Park neighborhood. Placement of the proposed alignment in an existing 46-kV easement along the H-1 freeway on the extreme seaward edges of Village Park will minimize land use impacts to this community. The single-family residential area seaward of the H-1 freeway is separated from the proposed transmission lines by the freeway and will not be adversely affected.

In the Paiwa Interchange area, residential and commercial proposed projects include the Amfac/JMB Waikale residential project and a retail commercial complex for national manufacturing outlets. Some of these planned residential and commercial areas are under construction. Impacts to the proposed retail commercial complex and other properties within Amfac's Waikale project could be minimized by keeping the transmission lines close to the freeway and by using the existing Navy easements at the Paiwa Interchange.

5.1.1.2 Pearl City Section

The alignment within the area of the proposed action will follow the right-of-way of a bike path on Navy property east to Waimano Stream and continue southeast along the bike path through the Waiau Power Plant. This alignment will limit use of the bike path during the

construction period. The alignment will be east of Lehua Elementary School and will not affect the school. The limited wetland farming plots in the area will not be affected.

5.1.2 Mitigation

Long-term land use impacts to proposed residential development will be avoided by appropriate setbacks of residential areas from overhead transmission lines.

Short-term impacts to the bike path will be mitigated by maintaining paved areas for bicyclists to use during installation of the poles and conductors.

5.2 Visual Resources

5.2.1 Impacts

In keeping with the objectives of the City and County of Honolulu, views from public streets and thoroughfares were analyzed for possible visual impact, as discussed below.

5.2.1.1 *Waipahu Section*

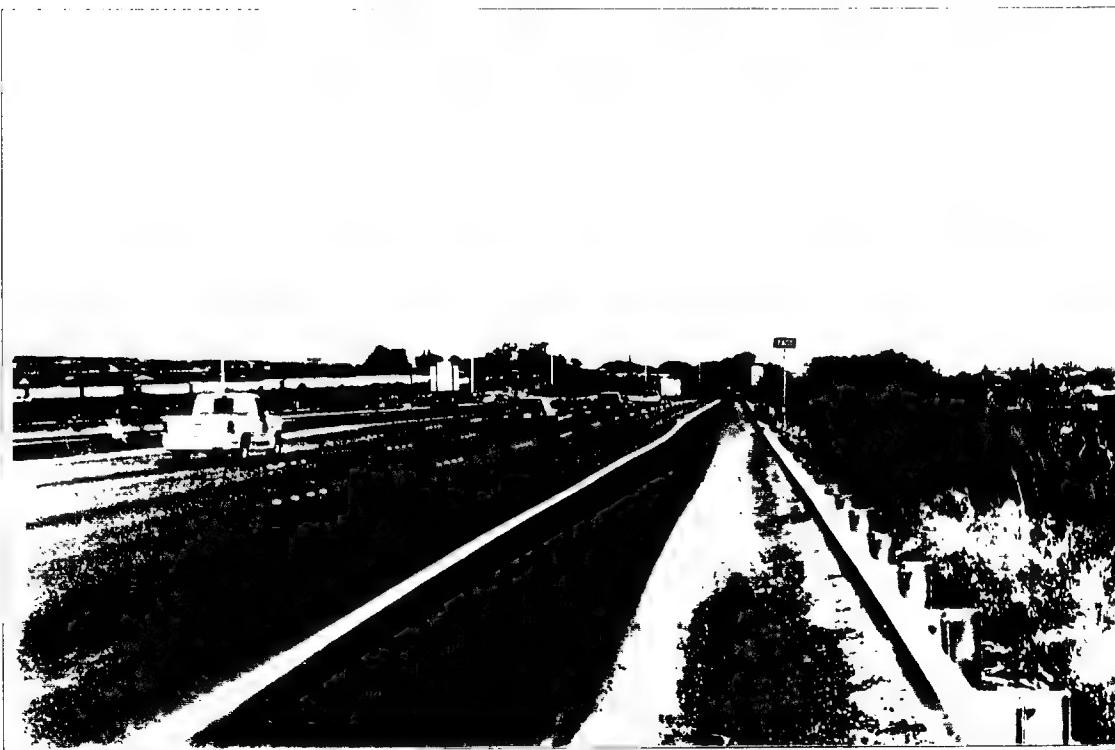
The visual impact of the overhead transmission lines is a function of the natural and man-made environment's ability to absorb introduced features. Figure 5-1 simulates the visual impact of the project looking towards the mountains from H-1 near Village Park in the general vicinity of the Waikeli Gulch project area. Figure 5-2 simulates the view of the project area from within Village Park looking in a seaward direction. Figure 5-2 can be generalized to show how seaward views will be affected in the Paiwa Interchange area after residential construction.

Mountain views from H-1 near Village Park show a relatively flat terrain without any predominant land features, which would make the overhead transmission lines visible from this vantage point. However, as planned and proposed development occurs inland of the H-1 freeway, the visual impact of the Waipahu section of this line is expected to lessen. Placement of the alignment along H-1 at the extreme inland edges of planned and proposed urban areas will lessen the visual impact of the transmission line.

In seaward views from Village Park, the transmission line's visual impact lessens considerably because of distance, and because it visually merges into the Waipahu urban landscape of residential areas and roadways in the near middleground. Distant seaward views to Pearl Harbor are not appreciably affected. Seaward views from the Paiwa Interchange area after full development of the land would be similar.



Existing Conditions



Simulation of Proposed Project

FIGURE 5-1

FROM H-1 NEAR VILLAGE PARK
LOOKING INLAND

**Waiau-
Campbell Industrial Park
Transmission Line Project**
Hawaiian Electric Company

CHM HILL



Existing Conditions



Simulation of Proposed Project

FIGURE 5-2

FROM VILLAGE PARK
LOOKING SEAWARD

**Waiau-
Campbell Industrial Park
Transmission Line Project**
Hawaiian Electric Company
CH2MHILL

The *Coastal View Study* (City and County of Honolulu, 1988) identified two coastal views as significant stationary views in the Waipahu section, at Waipahu Intermediate School and at Waipahu High School. Both viewing areas are seaward of the proposed alignment and will not be adversely affected.

5.2.1.2 Pearl City Section

The alignment within the area of the proposed action will require installation of poles and transmission lines along a bike path on the seaward edge of the H-1 freeway just east of Lehua Elementary School to Waimano Stream, and into the Waiau Power Plant. Existing 46-kV lines will most likely be relocated to the steel poles. The abandoned, wooden poles will likely be removed by the Navy to accommodate future development plans. Views seaward toward Pearl Harbor from the H-1 freeway generally will not be interrupted because viewers would look between the widely spaced poles to the shoreline.

The *Coastal View Study* identified one coastal view as a significant stationary view in the Pearl City section. This viewing area, Leeward Community College, is located seaward of this alternative and will not be adversely affected.

5.2.2 Mitigation

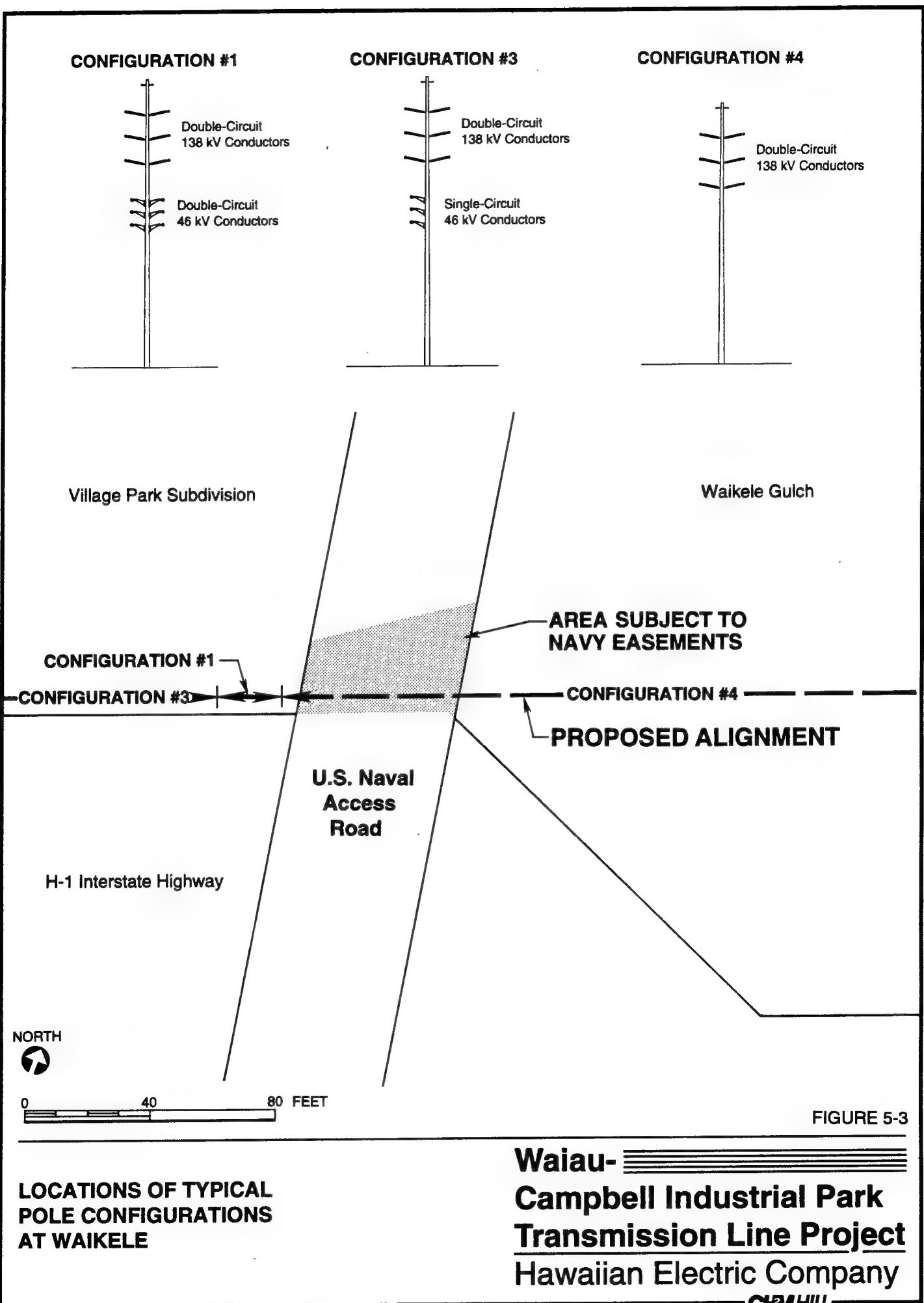
To soften the visual impact of the transmission line poles, the poles will be a neutral color that blends into the landscape. To reduce the visual clutter of transmission lines and poles, where possible, existing lower voltage transmission lines that occupy the same alignment will be suspended (underbuilt) on the same pole. With this arrangement, fewer poles will be needed for the same distance because longer spans between poles are possible with the high-voltage transmission line. Overall, this will reduce visual clutter at the pedestrian level.

5.3 Electric and Magnetic Fields

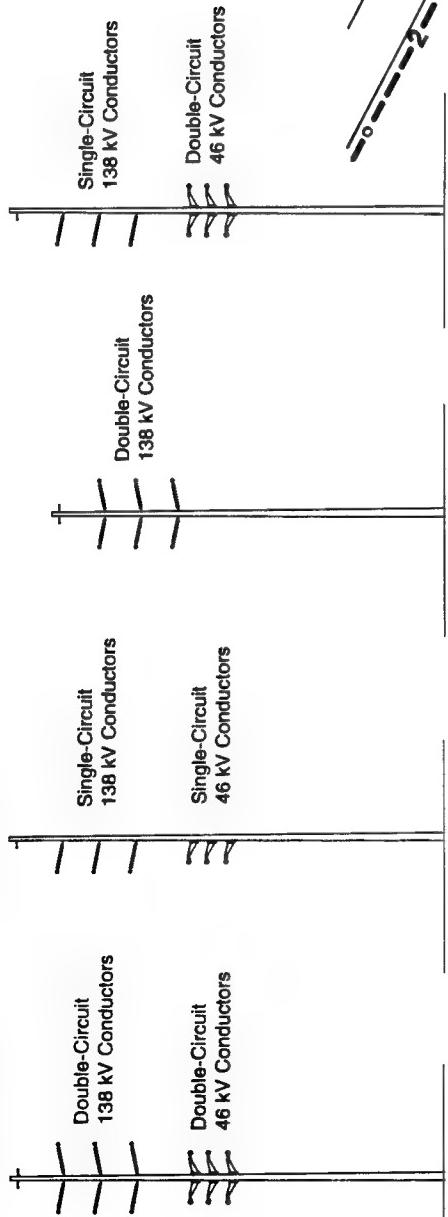
5.3.1 Electric Field Values for the Proposed Project

Electric field values for the six pole configurations along the alignment will be less than 0.5 kilovolts/meter. Figures 5-3 and 5-4 illustrate the pole configurations and their locations relative to the project area subject to Navy easements.

Where 138-kV lines are installed on the same pole as lower-voltage lines, some arrangements of conductors ("low-reactance phasing") can reduce electric field strengths because the interaction of the different opposite (or "unlike") phases can reduce electric field strengths. The electric field values for the power lines are based on low-reactance phasing. HECO proposes using low-reactance phasing in locations where the 138-kV lines will share poles with lower-voltage conductors; Figures 5-3 and 5-4 show these locations.



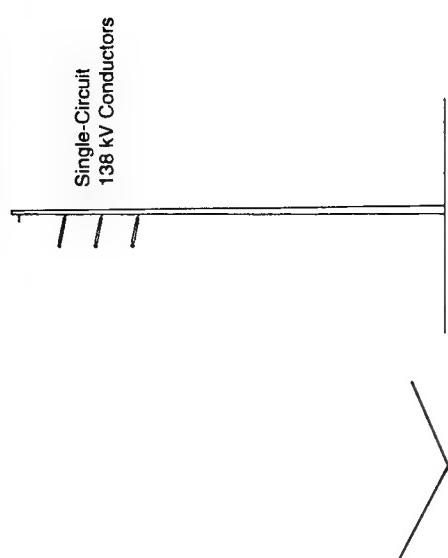
CONFIGURATION #6



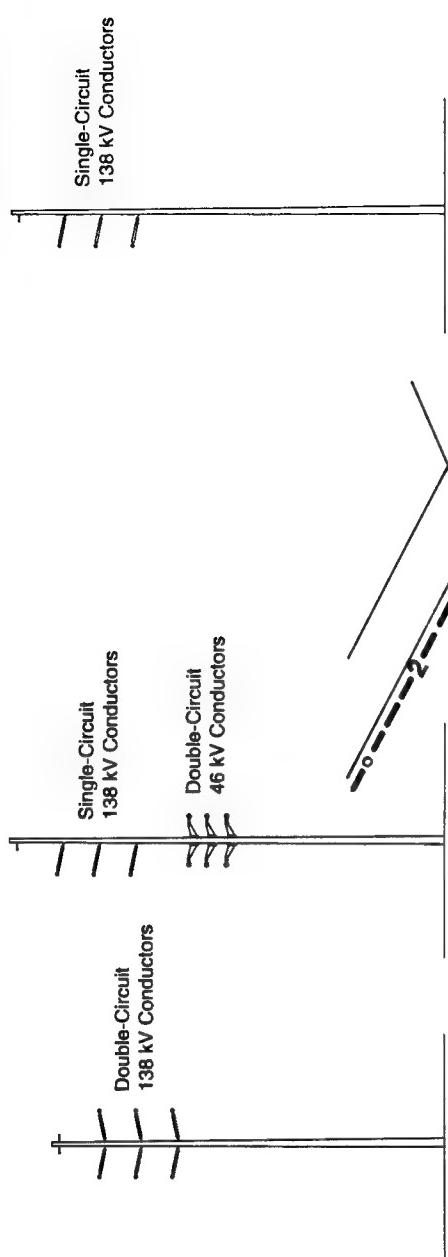
CONFIGURATION #2

CONFIGURATION #4

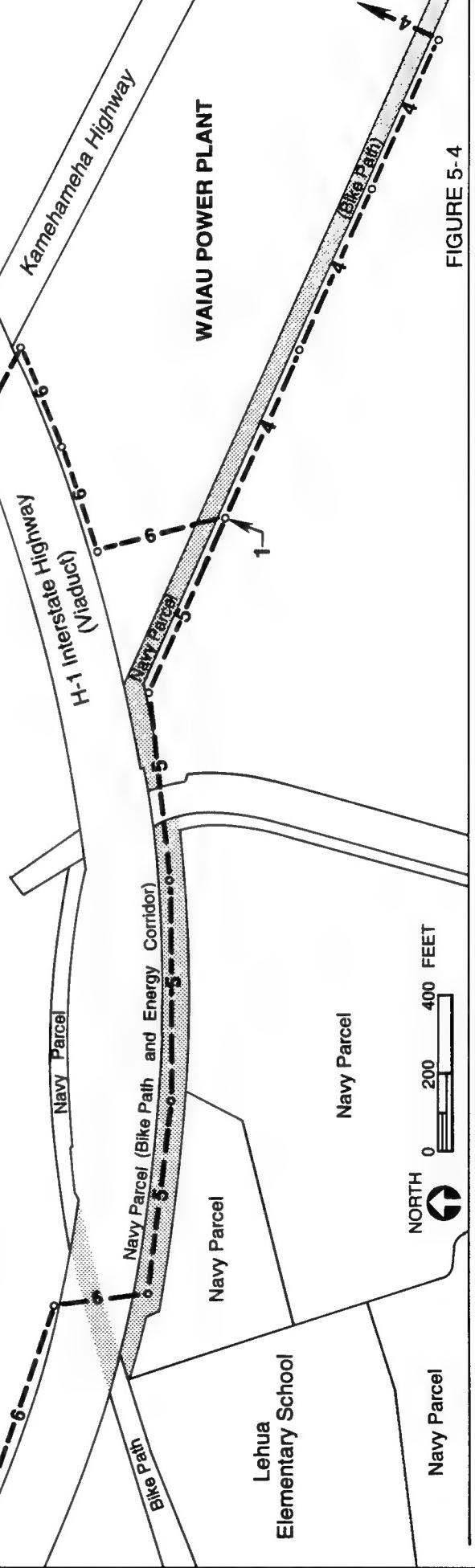
CONFIGURATION #5



CONFIGURATION #6



CONFIGURATION #1



LOCATIONS OF TYPICAL POLE CONFIGURATIONS AT WAIAU

**Waiau-
Campbell Industrial Park
Transmission Line Project**
Hawaiian Electric Company **C&H**

Navy parcel subject to easement

○ Proposed Alignment
5 Configuration Number

EIGENVECTORS

FEE

5.3.2 Magnetic Field Levels for the Proposed Project

The magnetic field values for the six pole configurations are presented in Table 5-1 for normal loads and in Table 5-2 for emergency loads. The results are presented as magnetic field levels on both sides of the lines, as a function of distance from the centerline of the poles. Figures 5-5 through 5-10 graphically illustrate magnetic field levels for the six pole configurations.

For unusual situations, the proposed lines could operate under a maximum heavy or emergency loading situation that would temporarily increase magnetic field values. These conditions will be rare and of short duration (e.g., a few hours).

5.3.3 EMF Calculation Assumptions

HECO calculated the project's magnetic field levels based on a set of load currents, line design details (pole configurations), and phasing. The assumed load currents are shown in Figures 5-5 through 5-10. Pole configuration details are shown in Figure 3-3. The currents are assumed to be balanced (numerically equal for both of the double-circuit lines) and in the same direction. Conditions differing from these assumptions (e.g., unequal loading of the circuits and/or opposite directions of power flow) would result in less cancellation from unlike phasing and, hence, higher fields. A system load flow study will be necessary to validate these general assumptions and finalize the optimum phasing for reduced field levels. HECO proposes to conduct such a study to determine optimum phasing and to make magnetic field measurements at locations selected in consultation with community representatives, before and after the lines are operating, to compare calculated levels with actual magnetic field levels.

5.3.4 Health Effects of Electric and Magnetic Fields

5.3.4.1 Overview

A number of studies in the 1960s and early 1970s found no obvious harmful effects from typical transmission line electric and magnetic fields. Some studies during this period reported the potential for harmful effects. More recent reports (since about 1979) have suggested a possible association between occupational and residential exposure to magnetic fields and adverse health effects, such as cancer. The evidence for such an association is still inconclusive, and studies are under way to obtain more definitive information on this subject.

5.3.4.2 New York State Power Lines Project

One of the most comprehensive recent research programs comprised 16 studies and 2 follow-up projects conducted from 1985 through 1987. These studies, administered by the New York State Power Lines Project, were undertaken "to determine whether there are health hazards associated with electric and magnetic fields produced by 60 Hz power transmission lines (especially 765-kV lines)." The \$5 million research effort was funded by electric utilities that serve the State of New York and was supervised by a scientific advisory panel reporting to the New York State Health Department. In general, the field levels used in the laboratory studies were larger than typical fields because of the 765-kV lines.

Table 5-1
Estimated Magnetic Field Levels for Pole Configurations
Normal Loadings
(milliGauss)

Typical Pole Configuration	Distance on Either Side from Centerline of Pole (feet)					
	0	10	20	30	40	50
No. 1 Double-circuit 138 kV Double-circuit 46 kV underbuild	6.5	6.4	6.1	5.5-5.6	4.8-4.9	4.0-4.1
No. 2 Single-circuit 138 kV Single-circuit 46 kV underbuild	14.8	14.4-14.9	13.5-14.7	12.4-14.1	11.1-13.0	9.8-11.7
No. 3 Double-circuit 138 kV Single-circuit 46 kV underbuild	7.5	7.2-7.5	6.7-7.0	5.9-6.1	5.1-5.2	4.2-4.4
No. 4 Double-circuit 138 kV No underbuild	19.9	18.8-18.9	16.2-16.3	12.9-13.0	9.9-10.0	7.5
No. 5 Single-circuit 138 kV Double-circuit 46 kV underbuild	17.8	17.3-17.6	16.4-16.5	14.8-15.4	13.0-14.0	11.2-12.5
No. 6 Single-circuit 138 kV No underbuild	17.8	16.9-17.9	15.6-17.4	14.0-16.2	12.3-14.7	10.7-13.0

Notes:
 Edge of typical right-of-way from centerline of double-circuit alignment (configurations 1, 3, and 4) is 37.5 feet.
 Edge of typical right-of-way from centerline of single-circuit alignment (configurations 2, 5, and 6) is 20 feet.
 Magnetic field levels are for midspan locations where power lines would be closest to ground level.

Source: HECO, 1994.

Table 5-2
Estimated Magnetic Field Levels for Pole Configurations
Emergency Loadings
(milliGauss)

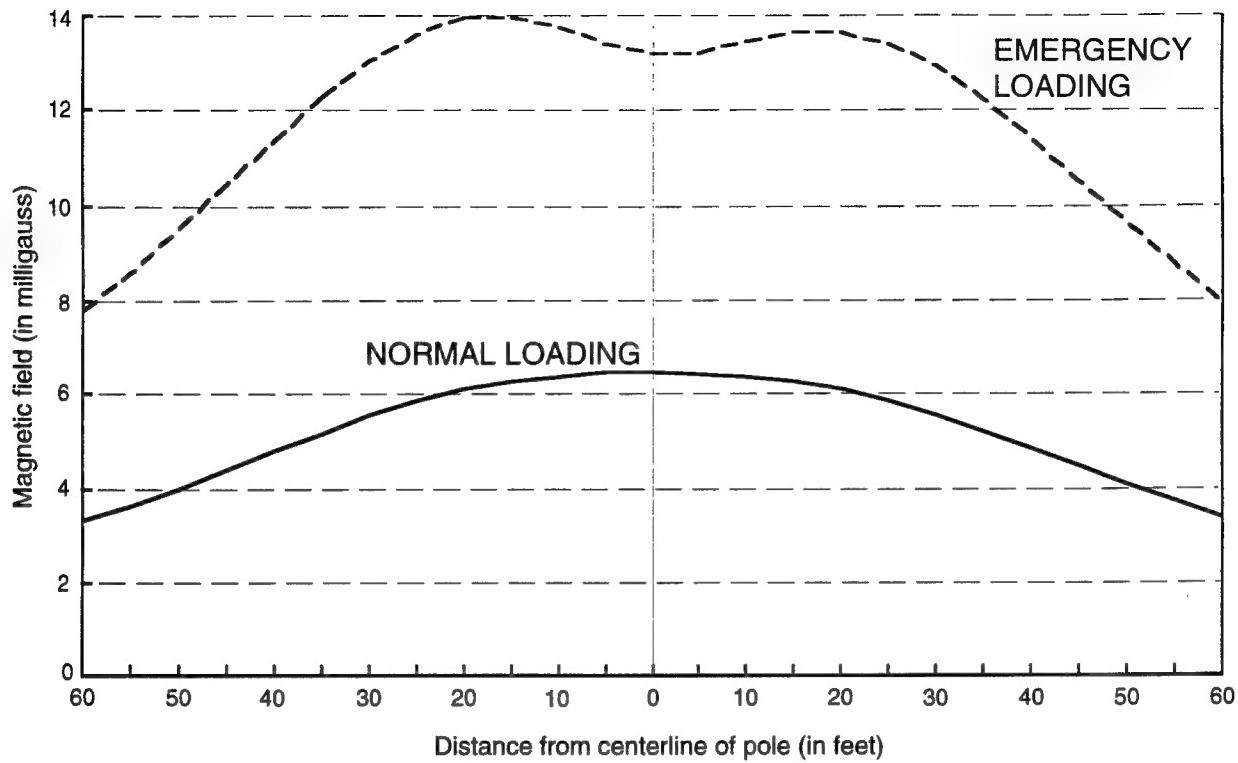
Typical Pole Configuration	Distance on Either Side from Centerline of Pole (feet)					
	0	10	20	30	40	50
No. 1 Double-circuit 138 kV Double-circuit 46 kV underbuild	13.2	13.4-13.7	13.7-13.9	12.9-13.0	11.4	9.5-9.6
No. 2 Single-circuit 138 kV Single-circuit 46 kV underbuild	29.4	29.4-29.7	28.7-30.4	26.8-30.1	24.3-28.5	21.5-25.9
No. 3 Double-circuit 138 kV Single-circuit 46 kV underbuild	23.3	21.0-24.1	18.5-22.6	16.2-19.2	14.1-15.4	12.0
No. 4 Double-circuit 138 kV No underbuild	54.3	51.1-51.2	43.3-43.5	34.0-34.2	25.6-25.8	18.9-19.1
No. 5 Single-circuit 138 kV Double-circuit 46 kV underbuild	44.7	40.8-46.4	37.6-44.0	35.1-39.0	32.3-33.5	28.4-29.0
No. 6 Single-circuit 138 kV No underbuild	43.8	41.6-44.3	38.1-42.7	33.9-39.7	29.7-35.7	25.8-31.5

Notes: Edge of typical right-of-way from centerline of double-circuit alignment (configurations 1, 3, and 4) is 37.5 feet.

Edge of typical right-of-way from centerline of single-circuit alignment (configurations 2, 5, and 6) is 20 feet.

Magnetic field values are for midspan locations where power lines would be closest to ground level.

Source: HECO, 1994.



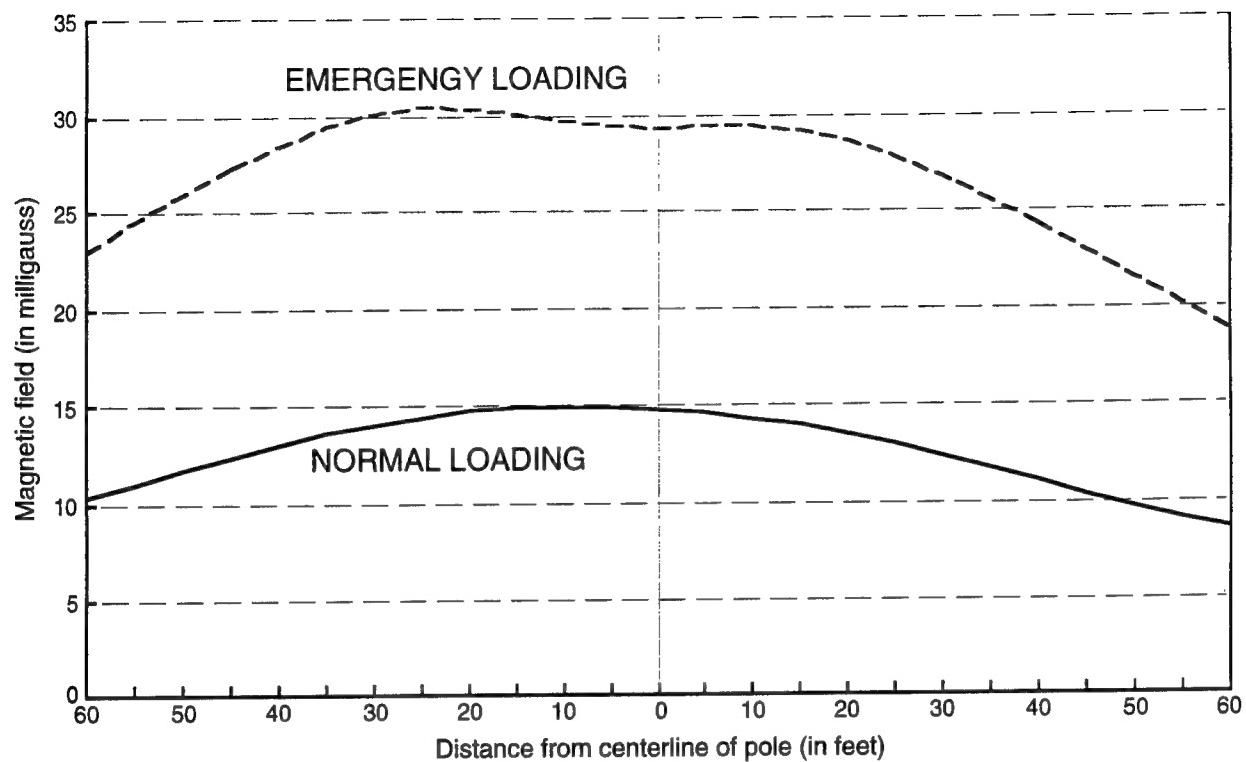
CONFIGURATION #1:
 Double Circuit 138 kV Conductors
 Double Circuit 46 kV Conductors

CIRCUIT	ASSUMED LOADING PER PHASE	
	NORMAL	EMERGENCY
138 kV	765 amps	1800 amps
46 kV	150 amps	715 amps

FIGURE 5-5

LATERAL PROFILE OF MAGNETIC FIELD FOR CONFIGURATION #1

Waiau- ■■■■■ Campbell Industrial Park Transmission Line Project Hawaiian Electric Company
CH2M HILL



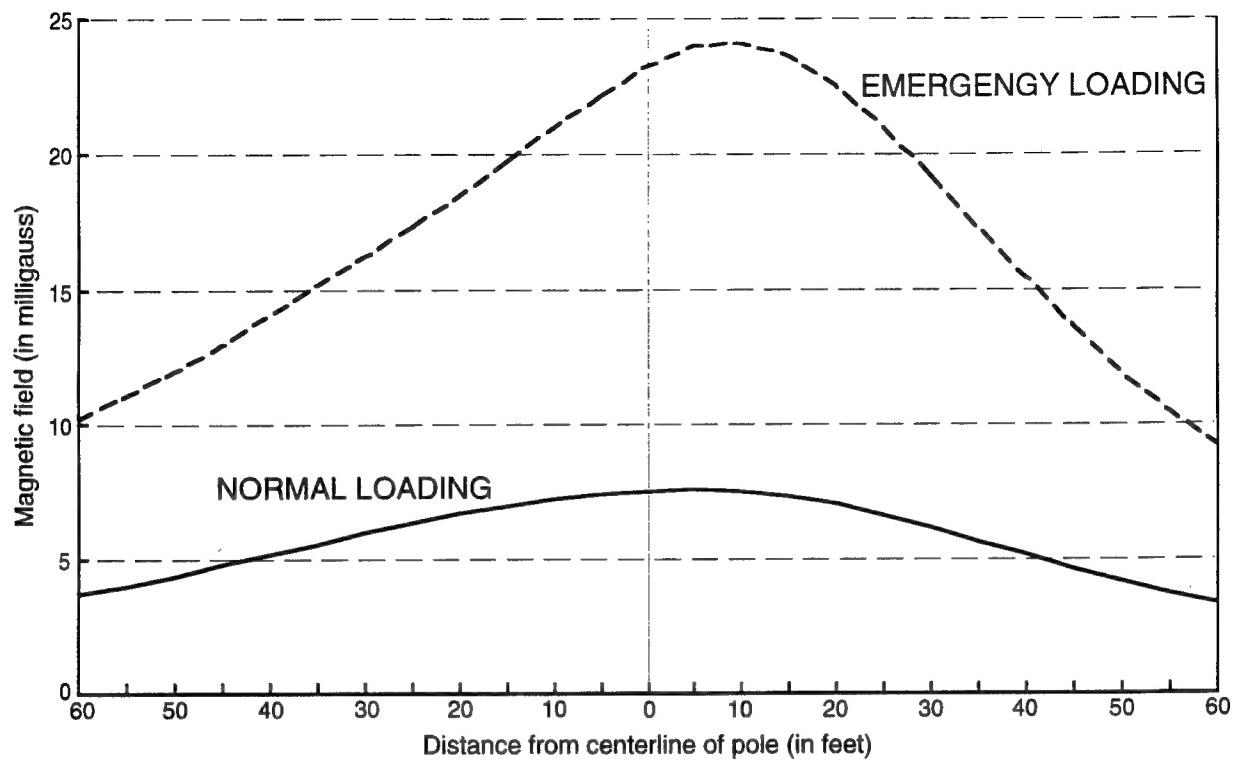
CONFIGURATION #2:
 Single Circuit 138 kV Conductors
 Single Circuit 46 kV Conductors

CIRCUIT	<u>ASSUMED LOADING PER PHASE</u>	
	NORMAL	EMERGENCY
138 kV	765 amps	1800 amps
46 kV	150 amps	715 amps

FIGURE 5-6

**LATERAL PROFILE OF
MAGNETIC FIELD FOR
CONFIGURATION #2**

Waiau- Campbell Industrial Park Transmission Line Project
Hawaiian Electric Company
CH2M HILL



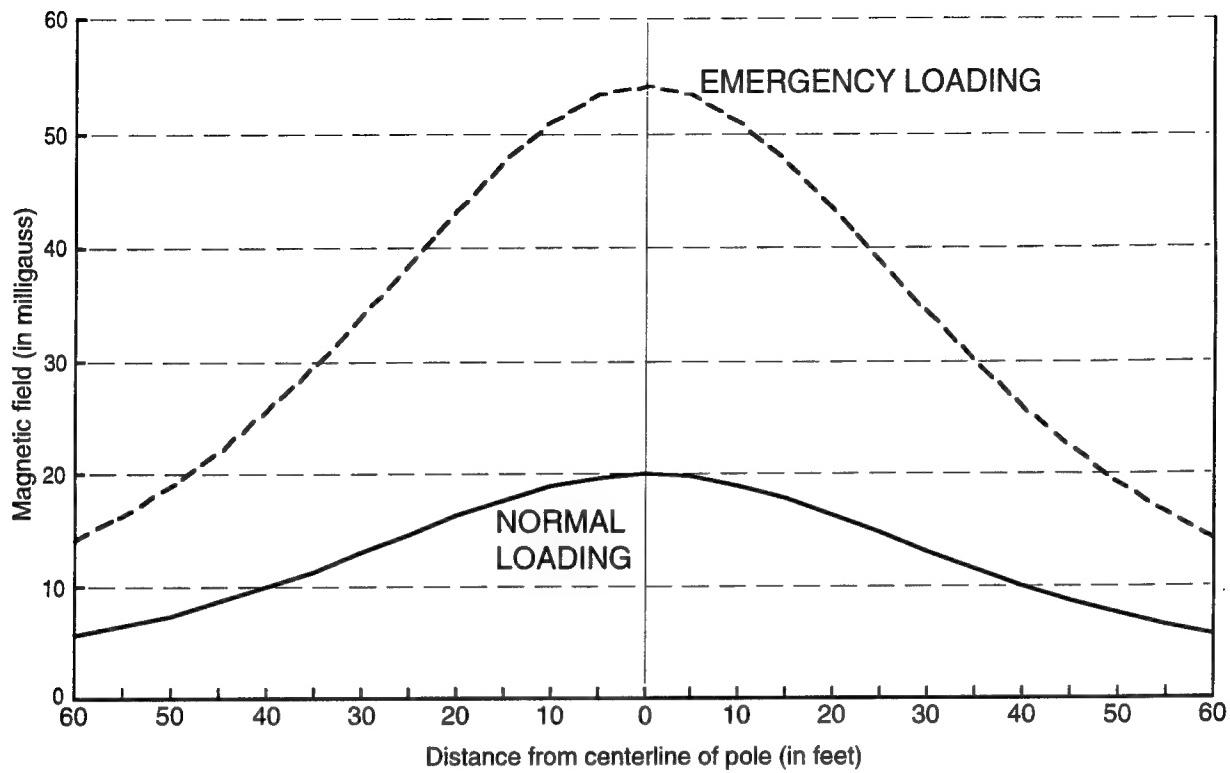
CONFIGURATION #3:
 Double Circuit 138 kV Conductors
 Single Circuit 46 kV Conductors

CIRCUIT	ASSUMED LOADING PER PHASE	
	NORMAL	EMERGENCY
138 kV	765 amps	1800 amps
46 kV	150 amps	715 amps

FIGURE 5-7

LATERAL PROFILE OF
 MAGNETIC FIELD FOR
 CONFIGURATION #3

**Waiau-
 Campbell Industrial Park
 Transmission Line Project
 Hawaiian Electric Company**
CH2M HILL

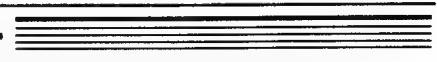


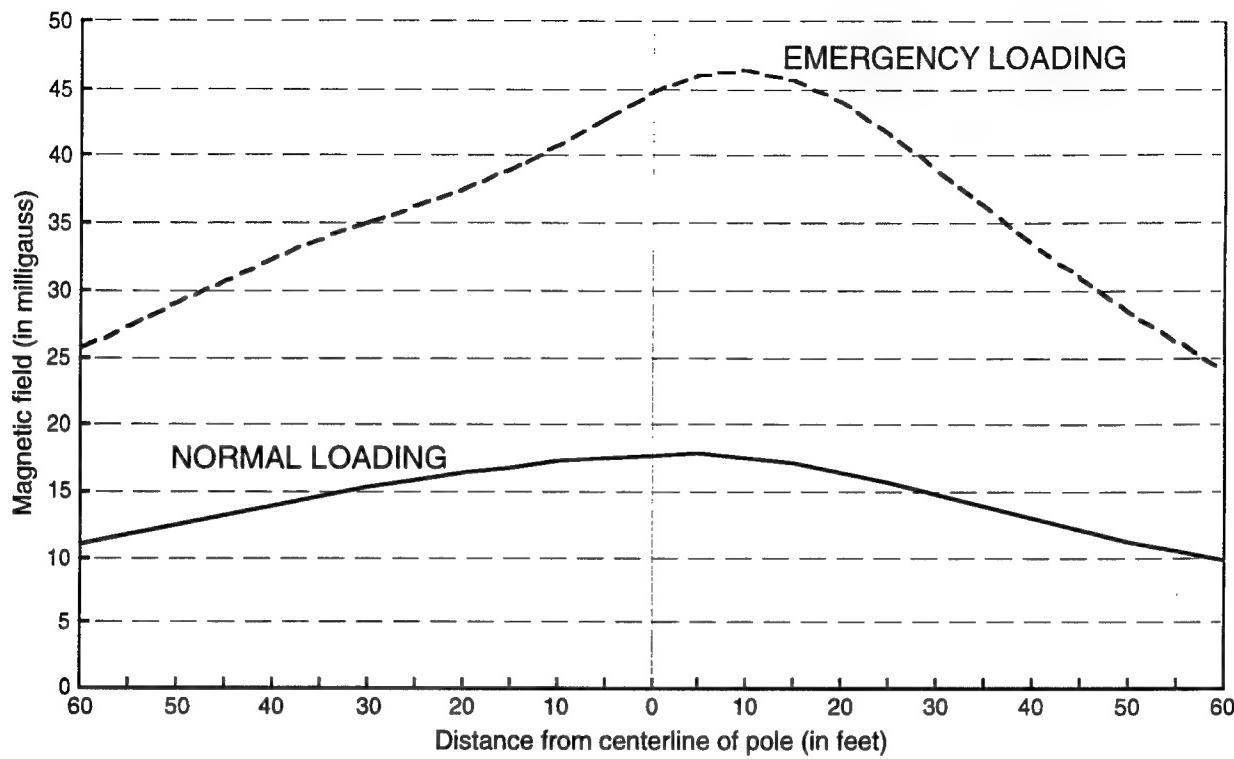
CONFIGURATION #4:
 Double Circuit 138 kV Conductors
 No 46 kV Conductors

CIRCUIT	ASSUMED LOADING PER PHASE	
	NORMAL	EMERGENCY
138 kV	765 amps	1800 amps

FIGURE 5-8

**LATERAL PROFILE OF
 MAGNETIC FIELD FOR
 CONFIGURATION #4**

Waiau- 
Campbell Industrial Park
Transmission Line Project
Hawaiian Electric Company
CH2M HILL



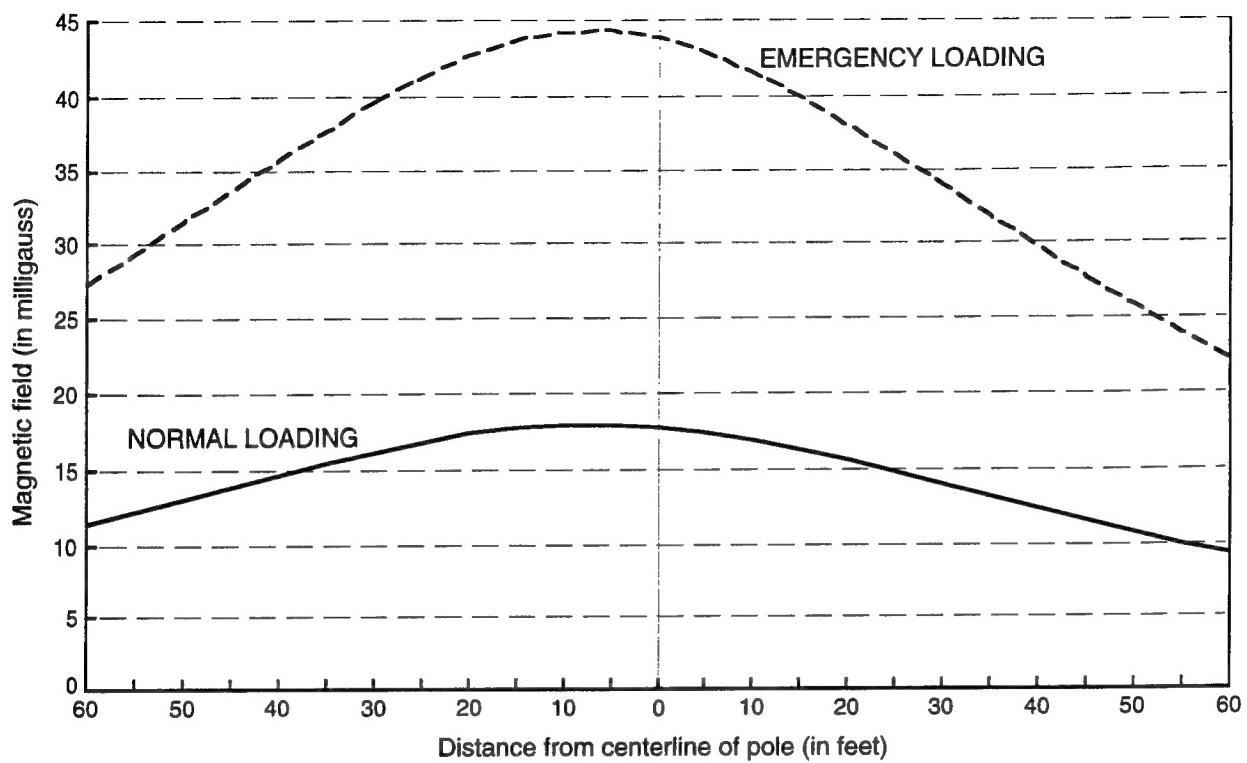
CONFIGURATION #5:
 Single Circuit 138 kV Conductors
 Double Circuit 46 kV Conductors

CIRCUIT	<u>ASSUMED LOADING PER PHASE</u>	
	NORMAL	EMERGENCY
138 kV	765 amps	1800 amps
46 kV	150 amps	715 amps

FIGURE 5-9

LATERAL PROFILE OF MAGNETIC FIELD FOR CONFIGURATION #5

Waiau- ■■■■■
Campbell Industrial Park
Transmission Line Project
Hawaiian Electric Company
CH2M HILL



CONFIGURATION #6:
Single Circuit 138 kV Conductors
No 46 kV Conductors

CIRCUIT	<u>ASSUMED LOADING PER PHASE</u>	
	NORMAL	EMERGENCY
138 kV	765 amps	1800 amps

FIGURE 5-10

**LATERAL PROFILE OF
MAGNETIC FIELD FOR
CONFIGURATION #6**

**Waiau- ■■■■■
Campbell Industrial Park
Transmission Line Project
Hawaiian Electric Company**
CH2M HILL

The studies fall into the broad areas of epidemiology, laboratory animal, and cellular research. None of the studies revealed significant adverse effects on reproduction, growth, or development because of the laboratory-created fields; nor was there significant evidence of genetic or chromosomal damage that might lead to inherited effects or that might cause cancer. Two of the project's epidemiological studies, however, also examined the effects of lower-voltage distribution lines. These two studies (of childhood cancer in Denver and adult cancer in Seattle) have generated much public interest.

The Denver Study. The Denver study evaluated the incidence of cancer among children living in homes near different kinds of electric power lines. Measurements were taken inside each home with appliances turned off (low-power condition) and turned on (high-power condition). Distribution "wiring configuration codes" were used as a surrogate for likely magnetic field exposures over time in the home from external power lines. The wiring code is an index loosely based on the type, number, and diameter of conductors; the distance from house to power line; and the number of nearby service drops.

The New York Scientific Advisory Panel interpreted the Denver study to show an association between the household wiring codes and street addresses of the childhood cancer cases. The panel reported that the study appeared to show an increase in the frequency of childhood cancer in Denver from about 1 in 10,000 children per year to about 1.7 in 10,000. However, the study results were puzzling in several respects. There appeared to be no correlation when high-power condition measurements were used (that is, with many electrical appliances turned on). No clear relationship between the level of exposure and the increased incidence of cancer could be discovered for the low-power conditions (appliances turned off) for which a correlation with childhood cancer was found. The New York Scientific Advisory Panel was also concerned about the study's low interview response rate and possible coincidental factors, such as traffic density, that could also affect the incidence of cancer.

The Seattle Study. The other epidemiological cancer study funded by the New York State Power Lines Project was conducted in the Seattle area. The design of this study shared many features with the Denver study; for example, exposure to magnetic fields was assessed by field measurements and by the same wiring code system. In the Seattle study, the New York Scientific Advisory Panel found that "regardless of how exposure was characterized, no relationship with cancer incidence was disclosed." In other words, the results of this study were negative—no association between cancer and magnetic field exposure (as estimated by the wiring code system).

In evaluating the research results, the New York Scientific Advisory Panel cautioned that research has not found any biological mechanisms that could explain the role of magnetic fields in the development of cancer. The panel also noted that methodological uncertainties exist in quantifying magnetic field exposure levels. The panel concluded that the findings to date could not and should not be translated into specific recommendations for regulating right-of-way widths, line heights, or the location of lines near homes.

5.3.4.3 *The Los Angeles Study*

A residential epidemiology study conducted by Dr. John Peters and funded by the Electric Power Research Institute, was completed in 1990 in Los Angeles, California. The results generally confirm the results of the Denver study. There was an increased risk of cancer with certain wiring codes, but not for direct field measurements.

This study was essentially a replication of the Denver study, but in a different location. The researcher concluded that: ". . . our data offer no support for a relationship between measured electric field and leukemia risk, little support for the relationship between measured magnetic field exposure and leukemia risk, some support for a relationship between wiring configuration and leukemia risk, and considerable support for a relationship between children's electrical appliance use and leukemia risk." The reason that wiring configuration correlates with leukemia risk better than measured exposure does is not clear.

It remains unresolved why an indirect magnetic field measurement (such as wiring code) is associated with a positive finding, while direct field measurements are not. This is even more perplexing because this Los Angeles study had the most sophisticated direct measurements of magnetic fields to date. Possible explanations for these apparently contradictory research findings are:

- Wiring configuration codes are better predictors of long-term average magnetic field exposure than 24-hour measurements.
- Wiring code categories are markers for some as-yet-unidentified biologically effective characteristics of the magnetic field (e.g., transient pulses or intermittent fields).
- Some wiring code categories are associated with some confounding factor or set of factors in the urban environment that are the true cause of the increased risk but that are unrelated to magnetic fields.
- Relatively subtle biases in subject selection (especially for the controls) have produced a spurious association between wiring codes and leukemia risk in the Denver and Los Angeles studies.

5.3.4.4 *EPA Preliminary Draft Report*

(The EPA's Office of Health and Environmental Assessment announced in July, 1993 that it has decided to postpone production of the final report indefinitely because of the unlikelihood that it would shed any new light on the EMF issue. Instead, it referred to the conclusions of reviews by the Oak Ridge Associated Universities and the British National Radiological Protection Board). The U.S. Environmental Protection Agency prepared a preliminary draft report in 1990 on electric and magnetic fields based on a review of existing scientific literature. The preliminary draft report evaluated the likelihood that electric and magnetic fields pose a risk for the development of cancer in humans. In this preliminary draft

report, EPA concluded that "with our current understanding, we can identify 60 Hz magnetic fields from power lines and perhaps other sources in the home as a possible, but not proven, cause of cancer in people." One problem cited by EPA is a poor understanding of the basic nature of the interaction between magnetic fields and biological processes. The EPA preliminary draft report states, "For example, a real possibility exists that exposure to higher field strengths is actually less hazardous than exposure to low field strengths. Because of this uncertainty, it is inappropriate to make generalizations about the carcinogenicity of electric and magnetic fields."

EPA has also reviewed the research needs for electric and magnetic fields and published a report that identifies the major research topics and their relative priorities. Exposure assessment research and research into possible biophysical mechanisms were listed as two "high-priority" areas of future study. Definitive exposure data will be necessary in order to judge the validity of the suggested causal link between magnetic field exposure and cancer. A better understanding of possible biophysical mechanisms is needed to quantify which, if any, aspect of magnetic field exposure might be related to adverse health outcomes.

5.3.4.5 *EPA Science Advisory Board*

On January 29, 1992, the Nonionizing Electric and Magnetic Fields Subcommittee of the Science Advisory Board's Radiation Advisory Committee submitted to the EPA Administrator its report, *Potential Carcinogenicity of Electromagnetic Fields*, on the EPA's preliminary draft report on electric and magnetic fields. In its report, the Science Advisory Board Subcommittee concluded that ". . . there is insufficient information to designate specific values of magnetic-field strength that may be hazardous to human health." The subcommittee made two specific policy recommendations:

Policy Recommendation No. 1: The Subcommittee is unanimous in its belief that the question of electric and magnetic field effects on biological systems is important and exceptionally challenging, and that the Subcommittee's advice to the EPA should be that the report should be rewritten by EPA, and then reviewed by the Science Advisory Board.

Policy Recommendation No. 2: EPA should complete its efforts with regard to radio frequency (RF) electromagnetic fields (including microwaves) and issue exposure guidelines independent of present issues pertaining to lower frequencies. The current EPA report inadvertently leads even the careful reader to conclude that the potential carcinogenicity of electric and magnetic fields of extremely low frequency (ELF), i.e., powerline frequencies is the only—or at least the principal—subject of concern with regard to nonionizing fields. Such a conclusion would reinforce the skewed and somewhat sensationalized picture presented to the public in recent years by the news media and government agencies responding to this publicity. The report should therefore declare explicitly that the attention given to nonionizing electric and magnetic fields derives in the first place from long-standing concern over the hazards of RF (including microwave) radiation. EPA has expended substantial

resources on the study of such radiation over a period dating back to the EPA's inception, and EPA should complete its efforts directed toward the issuance of RF exposure guidelines. RF fields present long-known and well-understood hazards such as temperature elevation in tissue and heat stress resulting from acute exposures against which users and the general public must be warned and protected. Any published exposure guideline should specifically identify the hazards from RF exposure.

5.3.4.6 *Office of Technology Assessment–Background Paper*

A comprehensive background paper on the biological effects of electric and magnetic fields was prepared for the U.S. Congress Office of Technology Assessment (Carnegie Mellon University, 1989). The paper discusses the present state of knowledge on the health effects of extremely low-frequency (60 Hz) electric and magnetic fields. A small brochure was also prepared that more concisely summarizes the background paper and various policy options.

The background paper provides a good overview of the sources and nature of electric and magnetic field exposure. It points out that it is not yet known what field attribute or combination of attributes, if any, could produce public health effects. This means that the simple assumption that "more is worse" may not be true. Because of this, simple field strength standards "cannot be adequately supported by the science that is now available."

The background paper also provides a summary of the basic areas for research: cellular experiments, whole animal experiments, exposure assessment, and epidemiological studies. Using the review of the scientific literature, the report states that:

As recently as a few years ago, scientists were making categorical statements that on the basis of all available evidence there are no health risks from human exposure to power-frequency fields. In our view, the emerging evidence no longer allows one to categorically assert that there are no risks. But it does not provide a basis for asserting that there is a significant risk.

If exposure to fields does turn out to pose a health risk, it is unlikely that high voltage transmission lines will be the only sources of concern. Power-frequency fields are also produced by distribution lines, wall wiring, appliances, and lighting fixtures. These nontransmission lines could play a far greater role than transmission lines in any public health problems.

The background paper and brochure also consider the public policy question of what should be done, given our present knowledge. Three basic approaches are suggested:

- **Do nothing.** Conclude that there is not yet enough evidence to warrant any action.
- **Prudent avoidance.** Adopt strategies that can limit field exposures with small investments of money and effort. Do nothing drastic or

expensive until research provides a clear picture of whether there is any risk at all.

- **Aggressive regulation.** Conclude that there is a problem and spend some serious time and money on an aggressive program to limit field exposure, while recognizing that we may eventually learn that some or all of this effort and money has been wasted.

5.3.4.7 *Oak Ridge Associated Universities*

In June, 1992, the Oak Ridge Associated Universities (ORAU) published an independent scientific review and evaluation of reported health effects from low-frequency electric and magnetic fields, such as generated by power lines and appliances. The review was prepared for the Committee on Interagency Radiation Research and Policy Coordination at the request of the U.S. Department of Labor, who was concerned about reports of cancers resulting from transmission lines and household appliances and reproductive problems attributed to video display terminals. The ORAU scientific panel reviewed about 1,000 journal articles published in the last 15 years.

The ORAU review indicated that, "there is no convincing evidence in the published literature to support the contention that exposures to extremely low-frequency electric and magnetic fields generated by sources such as household appliances, video display terminals and local power lines are demonstrable health hazards. Epidemiologic findings of an association between electric and magnetic fields and childhood leukemia or other childhood or adult cancers are inconsistent and inconclusive. No plausible biological mechanism is presented that would explain causality. Neither is there conclusive evidence that these fields initiate cancer, promote cancer or influence tumor progression. Likewise, there is no convincing evidence to support suggestions that electric and magnetic fields result in birth defects or other reproductive problems. Furthermore, any neurobehavioral effects are likely to be temporary and do not appear to have health consequences."

The ORAU review found evidence that electric and magnetic fields may produce some biological effects, such as changes in the pattern of secretion of the hormone melatonin and enhancement of healing bone fractures. These findings warrant consideration for further research in these areas. Overall, the ORAU report concludes that exposure to extremely low-frequency electric and magnetic fields "does not appear to constitute a public health problem."

5.3.4.8 *Swedish EMF Study*

A residential EMF study released on September 30, 1992, in Stockholm, Sweden, has indicated an association between estimated magnetic fields and childhood leukemia. The residential study involved 500,000 people who lived in proximity to 220-kV or 440-kV power lines between 1960 and 1985. The study estimated EMF exposure using

several methods including distance to the nearest line, wire codes, calculated historical magnetic field levels (based on annual mean load data), and a sampling of measured, present-day, 24-hour personal exposure. Exposure levels of 1 mG, 2 mG, and more than 3 mG were evaluated.

The Swedish study, still under peer review, seems to add support to findings from earlier studies that showed a weak correlation between EMF exposure and childhood leukemia. The study's results suggested that as EMF exposure increased, so did the relative risk of childhood leukemia. The EMF-leukemia association was confined to single-family homes although families in apartments also were part of the study. The authors attributed this discrepancy to a limited accuracy in exposure assessments in apartment buildings. The EMF association with childhood leukemia was found with calculated historical fields but not with spot measurements of EMF.

The Swedish study found no correlation between EMF exposure and all cancers and brain tumors when taken together. The study noted that what aspect of magnetic field is involved still remains unclear (Feychting and Ahlbom, 1992).

5.3.4.9 *Continuing Research*

Almost all researchers are careful to point out that it is difficult to identify health hazards that may be subtle to detect or that are evident only after long periods of time. The converse is also true: no experiment, no matter how well designed, can prove no health hazards at all from any source studied. The studies that do suggest a health effect are usually repeated to verify the results. Because any one study can be fallible, a study needs to be replicated before any conclusions can be reached about health hazards.

Because of the difficulty of reaching any meaningful conclusions about health hazards from the current studies, most researchers recommend carrying out additional research (New York State Power Lines Project, 1987; EPA, 1992). Several areas in particular merit further research:

- So far, research has not been able to discover the biological mechanism by which electric or magnetic fields might cause adverse health effects. Additional basic laboratory research is needed to determine whether physiological changes result from exposure to electric or magnetic fields, and how such changes might affect health.
- Another subject deserving further research is the effect of the fields typically experienced in homes—fields caused by televisions, electric blankets, hair dryers, other appliances, and electric wiring in house walls. As noted earlier in this section, although field strengths near some of the larger transmission lines may be larger than field strengths at home, most people experience significant exposure to electric and magnetic fields at home. The Denver and Los Angeles studies found evidence of an association between the incidence of childhood cancer

and the configuration of electric power line wiring outside the home. Further study will help clarify the relative risk, if any, from fields at home and near transmission or distribution lines.

5.3.4.10 Hawaii Public Utilities Commission

On April 7, 1994, the Hawaii Public Utilities Commission (PUC) issued Decision and Order No. 13201 approving the Waiau-CIP Transmission Lines, Part 2, Project as proposed by HECO and as described in this environmental assessment. In reaching its decision, the PUC considered the potential adverse health effects from the project's magnetic fields. Extensive testimony by national experts of different viewpoints was submitted during the evidentiary hearing and related proceedings. The PUC's decision on this issue is contained in its Decision and Order:

Based upon a thorough examination of all of the evidence presented in this docket with regard to the possible health effects of exposure to EMF, we find that a causal link between EMF and adverse health effects has yet to be established by those in the scientific community who have been researching this matter. A few studies, such as the Swedish studies mentioned above, appear to have established an association between EMF exposure and the occurrence of certain cancers. However, the results of these studies have yet to be accepted by the scientific community as proof that exposure to EMF causes cancer or other diseases.

In the absence of more definitive evidence on the health effects of EMF exposure, we find that we cannot order HECO to place the Waiau-CIP part 2 transmission lines underground as a result of EMF concerns. We will, however, expect HECO to exercise prudent avoidance with respect to EMF.

5.3.5 Electric and Magnetic Field Standards

The proposed 138-kV project has essentially adopted strategies consistent with the prudent avoidance approach specified in the Hawaii Public Utilities Commission Decision and Order No. 13201 concerning approval of the project, the U.S. Environmental Protection Agency's 1992 brochure titled *Questions and Answers About Electric and Magnetic Fields (EMF)*, and the State Department of Health's policy on EMF in routing and designing the proposed transmission line. Evaluating land use along the transmission line route options and different engineering design options (such as unlike or low-reactance phasing) is consistent with application of the prudent avoidance approach to this project. The use of unlike phasing (placing opposite phases next to each other) can significantly reduce field levels for the assumed magnitude and direction of current flow in each circuit. HECO proposes to use such a phasing strategy for this project.

The Hawaii Public Utilities Commission Decision and Order No. 13201 agrees that HECO exercised prudent avoidance in routing the line, from its Waiau facility to the Campbell Industrial Park area, by proposing to "design, construct and operate its facility in a manner

that will minimize EMF where technically feasible and economically reasonable." The PUC stated that HECO's route plans, along with design options such as unlike or low-reactance phasing, show that the utility practiced prudent avoidance in developing the line, even while forced by geography to route it through a populous area of Honolulu.

Before and after the lines are operational, HECO proposes to measure the actual magnetic field levels at locations along the alignment (selected in consultation with community representatives) to compare those levels with the calculated levels. The information will be made available to the public. HECO will design, construct, and operate its transmission lines in a manner that will minimize electric and magnetic fields where technically feasible and economically reasonable.

The Waiau-CIP Part 2 transmission lines' field values are far below any of the levels of standards in Table 4-6. The standards listed in Table 4-6 are generally acknowledged not to be health-based standards because the existing body of knowledge does not support the establishment of health-based standards. Where states have set standards, they have generally done so for equity reasons, with the intent of keeping future conditions about the same as past conditions. In this way, no radically new conditions will be created until more is known about the effects of electric and magnetic fields. As with the state standards, the Waiau-CIP Part 2 transmission lines' field values are far below the values cited in Table 4-7.

The transmission line project will also comply with the Hawaii PUC Rules for Overhead Electric Line Construction and the National Electric Safety Code, although these standards are not currently written to address concerns about health effects and electric and magnetic fields.

5.3.6 Other Transmission Line Electrical Factors

5.3.6.1 *Corona*

The engineering design of the proposed Waiau-CIP Part 2 transmission lines will produce very low conductor surface gradients (because of the lower 138-kV line voltage and the use of bundled conductors). The corona performance of the proposed 138-kV lines will be as good as or better than other lines in this voltage classification. In summary, the proposed 138-kV lines are expected to have little or no corona activity under most operating conditions.

5.3.6.2 *Audible Noise*

Noise levels on typical 138-kV systems are low and have not been a problem; in fact, audible noise is almost never reported on transmission lines below 230-kV (this will be especially true for the Waiau-CIP project because the 138-kV design will use bundled conductors). Audible noise levels for the proposed Waiau-CIP Part 2 transmission lines, calculated for the edge of the right-of-way during foul weather, are about 10 to 13 dBA, a very low level.

5.3.6.3 Radio and Television Interference

HECO engineers design all transmission lines to be as free as possible from corona and other sources of interference. Radio and television interference complaints are recorded, evaluated, and investigated when necessary; corrective measures are taken as required.

5.3.6.4 Ozone

Close to the Waiau-CIP Part 2 transmission lines, calculated ozone levels will be about 0.007 parts per billion (ppb). Concentrations below about 1.0 ppb are impossible to measure with even the most sensitive instrumentation. Nitrogen oxides can also be generated by transmission lines but on a scale much smaller than ozone, thus presenting a problem even less significant. Neither ozone nor nitrogen oxide is a problem associated with 138-kV transmission lines.

5.3.6.5 Cardiac Pacemakers

The electric fields associated with the Waiau-CIP Part 2 transmission lines (less than 0.5 kV/m) are far below levels that are reported as capable of affecting pacemaker operation (about 2 to 9 kV/m) and will, therefore, pose no hazards for pacemaker operation (University of Rochester, 1985; IITRI, 1979).

5.3.6.6 Induced Current

The induced current that could occur in underground oil and gas pipelines paralleling the 138-kV transmission line could cause corrosion of the underground pipelines. This impact can be eliminated by installing cathodic protection for these underground pipelines. HECO will install such protection in consultation with the owners and operators of the pipelines. Where cathodic protection systems already exist, HECO will investigate the transmission line's effect on the systems to determine what measures HECO will take to ensure the proper functioning of the cathodic protection systems. The induced current in existing chain link fences along the preferred alignment can be eliminated by installing copper pins to the ground at intervals and connecting these pins to the metal fence posts. This procedure will cause the fence to be grounded. Where chain link fences exist, HECO will install these pins as part of the project construction and test the fences during initial operation of the transmission line to ensure public safety.

5.3.6.7 Ordnance Transport

The easement for the Waikeli Gulch area will allow HECO to span the Navy's access road to Naval Magazine Lualualei Waikeli Branch with a 138-kV transmission line. Electric field calculations indicate that road level field strengths will be between 100 volts per meter (V/m) and 400 V/m. Standards pertaining to the Hazards of Electromagnetic Radiation to Ordnance (HERO) are based upon the ordnance's degree of susceptibility to electric fields. Items that are negligibly susceptible and require no environmental restrictions during all phases of normal

employment are classified HERO SAFE. Items that are moderately susceptible and require moderate electric field environmental restrictions during one or more phases of employment are classified HERO SUSCEPTIBLE. Items that are highly susceptible and require severe restriction for some or all phases of employment are classified as HERO UNSAFE.

The calculated field strengths at the point where the proposed transmission line will cross the access road to the Naval Magazine indicate that both the HERO SUSCEPTIBLE criterion of 2 V/m and the HERO UNSAFE criterion of 0.2 V/m will be exceeded. Ammunition is always transported under U.S. Department of Transportation regulation and Navy policy which mandates that it be configured in a HERO SAFE condition. This can include foil wrapping, electronic shunting, or defusing. With proper adherence to the ammunition transport regulations and policies, no significant adverse impact is anticipated.

5.3.7 Conclusions

Research to date has not demonstrated conclusive evidence of health hazards from 138-kV transmission lines similar to the Waiau-CIP, Part 2, Project lines. HECO has adopted strategies consistent with the "prudent avoidance" approach in routing and designing transmission lines. These strategies include the use of low reactance phasing, where feasible, to reduce the electric and magnetic field strengths. Pre- and post-construction measurements of electric and magnetic fields will be conducted in consultation with nearby communities.

5.4 Biological Resources

5.4.1 Impacts

No substantial impacts on biological resources from either construction or operation of the proposed transmission lines within the areas of the proposed easements are anticipated. No undisturbed biological resources exist along the proposed transmission line route. About half the land along the proposed alignment is or has been used for agriculture, and the remaining portion of land is within urbanized areas.

Four endemic species of waterfowl, all of which are on the federal and state endangered list, have been known to use the wetland areas near the Waiau Power Plant. There is some concern that the proposed transmission line poles will stand taller than other poles and trees in the area. However, the probability of endangered species flying into the transmission lines is very low because the poles will be adjacent to the H-I viaduct and within the built section of the Waiau Power Plant where numerous tall structures and power lines already exist. No significant adverse impact to wildlife is expected. Consultations with the U.S. Fish and Wildlife Service have indicated that they agree with this determination of no significant adverse impact (see letter, Appendix B).

Nonwoody and cultivated wetlands located in the Special Management Area (SMA) near and in the Waiau Power Plant site will be avoided during construction associated with the proposed

alignment in that area. Poles will be placed to span wetlands, and will be reached through nonwetland areas for maintenance. A walking survey by U.S. Army Corps of Engineers staff encountered no wetlands along the proposed route (see Appendix A).

Under the proposed alignment, existing 46-kV lines in the SMA will be relocated to the proposed steel poles along the bike path. The remaining wooden poles in wetland areas will be removed by cutting the poles to grade and removing them by helicopter or by other means without driving equipment in the wetland area. This will cause minimal impact to the existing wetlands. In a few locations throughout the alignment, individual trees may need to be trimmed or removed to maintain safe conductor distances.

5.4.2 Mitigation

Prior to any construction near underground fuel lines, HECO will contact owners of existing gas and petroleum lines and determine whether spill contingency plans have been developed to respond to accidental spills. In the absence of a spill contingency plan, HECO will coordinate with the Honolulu Coast Guard Marine Safety Office, U.S. Fish and Wildlife Service, and the National Marine Fisheries Service (NMFS) to establish appropriate construction mitigation measures. Mitigation measures will include field testing for the location of the existing pipelines, having a containment boom onsite, and placing silt screens around edges of any adjacent wetlands.

If a spill occurs, HECO will notify the Honolulu Coast Guard Marine Safety Office and the Hawaii Department of Health. The Coast Guard will implement a local response effort, including contacting USFWS and NMFS for advice on a natural resource damage assessment and restoration methods.

In areas being used for wetland cultivation, especially in the Waiau Power Plant SMA, poles will be placed to avoid disturbance to plantings. Trimming and removal of trees will be kept to a minimum.

5.5 Water Resources

5.5.1 Impacts

No substantial impacts on water resources from either construction or operation of the proposed transmission lines are anticipated. The two build alternatives would cross Waimano Stream and Waikeli Streams. Construction will not alter any existing stream channels and will not affect the navigable waters of the United States. Where the proposed lines cross Waimano Stream, all poles will be sited outside the stream channels and no alteration will be made to the channels. No dredging or filling has been identified in connection with this proposed project and no discharges into surface waters or any violations of federal, state, or county water quality standards are anticipated.

Consultation with the U.S. Army Corps of Engineers permit branch indicates that Sections 10/404 are not applicable (see Appendix A).

5.5.2 Mitigation

Proper care will be taken when drilling pole foundations to avoid penetrating the caprock that overlies the aquifer. Caution will be exercised in preparing foundations to provide sufficient support for each pole and to control water leakage from the aquifer. There are no groundwater-fed springs in the alignment area. No impacts to groundwater quantity or quality will occur if proper care is taken.

5.6 Earth Resources

5.6.1 Impacts

Most of the proposed Waiau-CIP, Part 2 alignment is underlain by Koolau basalt and older alluvium formations that have a relatively high bearing capacity and can support relatively large loads with proper design. In these formations, conventional drilled pier foundations would probably be practical for supporting the transmission poles. Recent alluvium soils are less suitable for supporting the pole foundation loads because of their low in-situ strength characteristics and the tendency for structures overlying this type of soil to settle.

Pile foundations may be required to support the transmission poles in the areas surrounding the Waiau Power Plant, where there are wet soils, soils with high shrink-swell potential, and recent alluvium. If these soft soils cannot support the heavy construction equipment used to install pile foundations, a temporary or permanent working platform may be required in the vicinity of the existing bike path to support the equipment during construction and for maintenance purposes. The construction will include a filter fabric and gravel stabilization layer (several feet) over the soft ground. Because the area of the bike path was previously disturbed, no significant impacts are anticipated from pile foundation installation.

Surface disturbance from siting a working platform or transmission poles will not significantly increase soil absorption or decrease the amount of surface runoff; there will be no permanent changes in absorption rates, drainage, or surface runoff. Areas of the preferred alternative along the edge of Waikele Gulch (with slopes greater than 20 percent) can be fairly easily avoided when selecting sites for transmission poles.

5.6.2 Mitigation

A full-scale geotechnical exploration, including borings and field and laboratory testing, is being developed and implemented for the final design stage of the project. Drilled pier/pile construction will be closely monitored by a geotechnical engineer to ensure that foundation support is achieved. Wherever possible, transmission poles will be sited in areas underlain by Koolau basalt and older alluvium, which make excellent bearing formations because of

their high-strength characteristics, and which reduce the need for deep siting of the poles. Drilling fluids will be avoided as much as practicable, as they may saturate and weaken the subsoil or rock. The holes will be advanced by auger drilling, bit chopping, or cutting.

Prompt placement of concrete in the prepared hole, as soon as it is completed, will occur to reduce probable caving in of the hole in occasional soft or loose areas. When soft soil conditions require siting of pile foundations, the piles will be spaced at a sufficient distance apart to minimize reduction in soil strength caused by pile group effect; a rigid pile cap will be provided to reduce the lateral movement. When siting piles in these soils, care will be taken not to puncture caprock, which could release groundwater into the project area.

Stabilization of the ground surface may be needed in soft ground areas to allow access for heavy equipment. If so, existing underground utilities will be identified and a determination made as to whether stabilization will affect any of these buried utilities.

Short-term impacts from soil erosion can be mitigated through use of silt curtains in the vicinity of streams.

Unforeseen soil conditions, such as perched groundwater, soft deposits, hard layers, or cavities, may occur in localized areas and may require additional probing or corrections in the field to attain properly constructed pole foundations. Therefore, a sufficient contingency fund will be developed to accommodate such possible extra costs.

5.7 Transportation and Traffic Impacts

5.7.1 Impacts

Work adjacent to a state road or highway, such as the H-1 freeway, requires a Permit to Perform Work on State Highways, which must incorporate a Traffic Control Plan approved by the DOT Highways Division. Access from the H-1 freeway to construct or maintain the lines is not permitted by state DOT regulations. No adverse impacts to transportation facilities are expected in the area subject to the proposed Navy action.

No adverse impacts to the interchange or Paiwa Road are anticipated. HECO does not anticipate any adverse effects to the traffic flow in the Paiwa interchange area during the construction phase. Construction of the foundations and the erection of poles can be done with minimal impacts to the traffic flow. No lane closures will be required. HECO is coordinating its plans for the proposed transmission lines with the Hawaii DOT.

Consultation with the Department of Transportation Airports Division indicates that the routing for the transmission lines associated with the proposed action and the 46-kV easement alternative will not require approval under Federal Aviation Administration Advisory Circular 70/7460-1G, Chapters 4, 5, and 9. The circular governs objects penetrating the air interference zone within navigation facilities.

Segments of the proposed Waiau-CIP alignment will require the transmission lines to overhang state highways and will require a Permit to Perform Work within a State Highway and "Extreme Case Exemption for Freeway Crossing of Utility Line." The permits are administrative authorizations issued by the Hawaii DOT Highways Division. Published notice and a public hearing are not required. Consultation with the Highways Division indicates that compliance with Hawaii Revised Statutes Chapter 343 is a prerequisite to actions on the permits. Such an EIS was prepared and accepted by the Hawaii DOT on August 26, 1992.

Segments of the proposed alignment will require the placement of transmission line poles within county-owned rights-of-way along county roadways and will require a Street Usage Permit and a Permit to Construct within a County Road Right-of-Way. The Street Usage Permit is an administrative authorization issued by the county's Department of Transportation Services after review of construction plans and proposed traffic control measures. The Permit to Construct within a County Road Right-of-Way (also known as a trenching or excavation permit) is an administrative authorization issued by the City and County of Honolulu Department of Public Works after review of construction plans by the Department of Land Utilization, the Board of Water Supply, the Department of Transportation Services, and utilities.

5.7.2 Mitigation

Construction workers and contractors will comply with state laws and City and County of Honolulu regulations regarding vehicle safety (e.g., marking, signing, flagging, lighting, and pilot vehicles), and will observe a Traffic Control Plan approved by the DOT Highways Division and the County Department of Transportation Services for any work adjacent to state roads and H-1 freeway.

5.8 Utilities, Pipelines, and Hazardous Waste Impacts

5.8.1 Impacts

The proposed action in the Waiau Power Plant area is in close proximity to the Navy's and Chevron's underground fuel pipeline. Impacts resulting from construction and operation of the transmission lines can be mitigated as discussed below.

There are no records of hazardous materials in this area. Therefore, the potential for adverse impacts associated with excavation into hazardous materials is considered low.

5.8.2 Mitigation

Prior to the foundation excavation, HECO will survey and probe the foundation locations to determine the exact location of all underground utilities and pipelines within the immediate vicinity. At the request of the U.S. Navy, HECO will locate foundations a minimum distance of five feet from the Navy Utility Corridor. HECO will contact all owners of each adjacent

utility and inform them of the construction schedule and method of construction. All contractors will be held responsible for installing below-ground foundations without damaging any existing utility lines during construction. Guidelines for work near U.S. Navy and Chevron pipelines will be followed. These guidelines include measures to maintain access and prevent damage to pipelines.

5.9 Air Quality

5.9.1 Impacts

Air quality impacts will be primarily short term, resulting from construction equipment exhaust emissions and dust (particulate) from construction operations. Ambient air quality will be temporarily affected in areas surrounding each pole excavation site. Construction will continually move from one section to the next, and particulate levels will not be highly concentrated in any one area, though they may be a temporary nuisance under especially windy, dry conditions. The contractor will be required to minimize airborne particulates through wind erosion control measures if soil and wind conditions indicate that this could become a problem. Emissions of pollutants from heavy vehicles and equipment used to excavate, transport equipment and supplies, and drive piles will be controlled with proper maintenance. There will be no long-term air quality impacts.

The only air quality impacts associated with normal operations will be from maintenance vehicle emissions. These are anticipated to be negligible. No impact to the air quality attainment status of the area will occur as a result of this project.

5.9.2 Mitigation

Contractors will be required to minimize dust emissions through wind erosion control measures. This will include keeping watering equipment available and using it whenever necessary.

Emissions of pollutants from heavy vehicles and equipment used for construction and transport will be controlled through proper maintenance. Contract provisions will spell out the need to comply with this requirement.

5.10 Noise

5.10.1 Impacts

Similar to air quality impacts, construction activity will also generate most of the noise impacts from the project. Onsite construction equipment, generally powered by internal combustion engines, may generate significant maximum noise levels. The actual noise level

at any particular receptor will depend on the number of pieces of equipment in operation and the level of noise generated by each piece of equipment.

Overhead transmission line construction includes foundation installation, pole erection, insulator installation, and conductor stringing, as described in Chapter 3. These activities will temporarily increase noise levels in the immediate vicinity. Table 5-3 compares typical sound levels of equipment used during construction with common noise sources. Construction of each segment of the line will require use of most of the construction equipment listed in the table at some point. These noise levels will decrease with distance from the construction site.

Noise impacts of the construction activities will be short term and intermittent. Noise impacts at any one location will last only a few days at a time as different phases of construction are completed. Short-term construction noise is generally accepted by nearby sensitive noise receivers, especially if construction schedules are enforced and no nighttime or early morning activity takes place.

Transmission pole installation activities in the vicinity of the Waiau Power Plant will most likely be heard at the nearby Lehua Elementary School and by residences located inland of the H-1 freeway. Construction noise levels are not expected to cause significant impacts at the nearby school or residences.

A comparison of construction sound levels in Table 5-3 with the current Oahu noise standards in Table 5-4 indicates that, for some periods, some construction activities are likely to exceed the noise standard. For example, if pile-type foundations are required near the Waiau Power Plant, pile-driving equipment will be used for installation. The noise levels created by the air compressor used for the pile driver may exceed the allowable standard daytime noise level.

If the construction noise level is expected to exceed the standard daylight acceptable level, HE CO must apply for a noise permit or noise variance. The approval of the permit may require mitigation by muffling the sounds of construction equipment or limiting the time of use to a specified period. In addition, all heavy vehicles used during construction must comply with Title 11, Administrative Rules, Department of Health, Chapter 42, Vehicular Noise Control for Oahu.

Table 5-3
Comparison of Transmission Line Construction
Equipment Noise with Other Common Sound Levels

Equipment	A-Weighted Sound Level at 50 Feet, Unless Otherwise Specified (dBA)
Broadcasting studio	20
Human voice—soft whisper (15 feet)	30
Light auto traffic (50 feet)	50
Air conditioning unit (20 feet)	60
Air compressor	67
Freeway traffic	70
*Crawler tractor (20 to 199 horsepower [hp])	72
*Wheeled tractor	72
Freight train	75
*Truck, pickup, and four-wheel drive	77
*Concrete mixer, truck-mounted	78
*Crawler tractor (200 to 450 hp)	78
*Pulling machine	78
*Tensioning machine	78
*Truck, mounted with boring equipment	78
*Truck, flatbed	78
*Truck, rear dump	78
*Dozer	82
*Crane, mobile (15- to 20-ton)	83
*Paving breaker	85
*Pneumatic tools	85
*Crane, mobile (50-ton)	88
Human voice—shout (0.5 foot)	100
Jet takeoff (2,000 feet)	105
*Single-action air compressor for pile driver	105
Auto horn (3 feet)	115
Jet takeoff (200 feet)	120

***Construction equipment.**
Adapted from Shell California Production, Inc. 1982.
Tomlinson, M. J. *Pile Design and Construction Practice*. Cement and Concrete Association, London. 1977.

Table 5-4 Allowable Noise Levels (dBA)		
Time	Zoning	
	Residential and Preservation	Hotel, Apartment, and Business
Daytime (7 a.m. to 10 p.m.)	55	60
Nighttime (10 p.m. to 7 a.m.)	45	50

Notes: Noise levels shall not exceed the allowable levels for more than 10 percent of the time (L_{10}) within any 20-minute period, except by permit issued under S11-43-6 of Hawaii Administrative Rules. Level measured at property boundary.

The allowable noise level for impulsive sound shall be 10 dBA above the values in this table.

No long-term operational noise of consequence is anticipated. During corona activity, transmission lines (primarily 345-kV and above) generate a small amount of audible noise. This noise from the line can barely be heard in fair conditions on the higher voltage lines and usually not at all on 138-kV lines. During wet weather, water drops collect on the conductor and increase corona activity so that a crackling or humming sound may be heard near the line. The noise is caused by small electrical discharges from the water drops. Audible noise decreases with distance from the line. This audible noise is normally not heard at all on 138-kV lines, even in very quiet areas.

For this project, a single conductor will be used, which reduces corona activity significantly. Audible operational noise levels for the project, calculated for the edge of the right-of-way during wet weather, are about 10 to 13 dBA, a very low level.

5.10.2 Mitigation

Drilled pier foundations will be used for installation of most of the poles within the area of the proposed action. These generate less noise than driven pile foundations.

Because noise in excess of 60 dBA may be generated during construction in areas that are zoned Apartment or Residential, a noise variance will be required. The noise variance is issued by the State Department of Health within 30 days of application. The approval of the permit may require muffling of equipment or further limits on construction hours and activities.

All heavy vehicles used during construction will comply with Hawaii Administrative Rules Title 11, Department of Health, Chapter 42, Vehicular Noise Control for Oahu.

Contract provisions will spell out acceptable work hours, and provisions to enforce compliance will be identified.

5.11 Cultural and Historic Resources

5.11.1 Impacts

The installation of transmission lines within the Navy easement areas will have no impacts on known cultural or historic resources. No cultural resource sites are known to exist along the proposed alignment. As shown in Figure 4-10, one area of the proposed action is located in unsurveyed areas near the Waiau Power Plant with high cultural resource potential. Even though these areas are designated as having high resource potential, they are highly urbanized or otherwise disturbed. As part of the routing study for this project, a brief field reconnaissance was conducted in the vacant portions of the area designated as having high cultural resource potential. This reconnaissance consisted of several transect sweeps on foot. No surface archeological features were noted.

Construction of the proposed transmission lines will include only the placement of poles; no trenching or site excavation is anticipated. The likelihood of finding subsurface archeological remains is very low. In a 12 May 1992 response to the Draft EIS for Waiau-CIP, Part 2, DLNR concurred that overhead lines are likely to have "no effect" on historic sites. As a result of a Section 106 consultation seeking a determination specifically for the granting of easements as proposed by this project, the State Historic Preservation Officer determined that this project would also have "no effect" upon historic sites (see Appendix C).

5.11.2 Mitigation

No adverse impacts to known archeological or historical resources are anticipated from the construction of the proposed transmission lines within the areas of the proposed action. If previously undetected prehistoric or historic sites are found during transmission line pole excavation, construction activity in the site area(s) will stop and the State Historic Preservation Officer will be contacted. Consultations with the State of Hawaii will determine what course of action will be taken if an unexpected site discovery is made. Field personnel involved in project construction will be informed about the potential for uncovering historic and/or prehistoric sites and about the proper procedures to follow if a previously unidentified site is discovered. An archaeologist will be present during all excavation work to monitor for archaeological resources.

5.12 Public Services

5.12.1 Impacts

No significant impacts to public services are anticipated from the proposed action. Maintenance requirements will be minimal and will not significantly impact public services. Lehua Elementary School, located seaward of the H-1 freeway near Lehua Avenue, will not be affected. Continuous public use of the bike path will be maintained during installation of the poles and conductors.

5.12.2 Mitigation

Paved areas of the bike path will be maintained to ensure continued public use during installation of the poles and conductors.

5.13 Summary

5.13.1 Irreversible and Irrecoverable Commitments of Resources

The proposed Waiau-CIP, Part 2, Project will require the irreversible and irretrievable commitment of a number of resources. These resources include the materials, capital, labor, and energy needed to plan, construct, operate, and maintain the transmission lines.

The commitment of land area within the preferred alignment will not necessarily be irreversible and irretrievable. Implementation of the proposed project will not result in the significant loss of natural or cultural resources.

5.13.2 The Relationship Between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

During project construction, traffic will be disrupted, there may be increased exhaust emissions and particulate levels, and there will be increased noise in some locations. These impacts will be short term; they will last no longer than the construction phase.

Residents, businesses, and industry will continue to require electricity for an indefinite time into the future. Transmission lines are a necessary means of distributing electricity from its source to its area of use. The use of electricity on the Island of Oahu requires use of a separate additional transmission corridor in order to prevent major system outages. Because the availability of a reliable energy source is critical to so many activities, there is a direct relationship between a properly functioning electrical transmission system and long-term productivity. By increasing system reliability through an additional transmission corridor, this project will greatly enhance long-term productivity.

5.13.3 Cumulative Impacts

Neither the proposed action of granting Navy easements to HECO nor the construction, operation, and maintenance of the overall Waiau-CIP 138-kV Transmission Line, Part 2, Project will cause significant cumulative adverse impacts.

The long-term impacts will be minor. Although there is no conclusive evidence of significant health risks from electric and magnetic fields of 138-kV transmission lines, this concern is addressed by using low-reactance phasing, where feasible, to reduce the electric and magnetic field levels.

5.13.4 Summary of Unresolved Impacts

In regard to public health impacts from electric and magnetic fields, research to date has not demonstrated conclusive evidence of adverse health effects caused by 138-kV transmission lines similar to the line that HECO proposes to construct for the Waiau-CIP, Part 2, Project. HECO continues to review and evaluate all scientific research on the health effects of transmission lines and will consider the results of that research in its transmission line decisions. HECO also continues to support the scientific research on the health effects of transmission lines. HECO's goal is to provide electric power to the people of Oahu while maintaining the highest safety standards for its employees and the public.

5.13.5 Relationship to Federal, State, and County Land Use Plans, Policies, and Controls

5.13.5.1 National Environmental Policy Act

This document has been prepared in compliance with the National Environmental Protection Act (NEPA) of 1972, the Council of Environmental Quality Regulations (40 CFR1500-1508), and the United States Navy Procedures for Implementing the National Environmental Policy Act (OPNAVINST 5090.1A).

5.13.5.2 National Historic Preservation Act

This proposed action is being carried out in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and 36 CFR 800 (implementing regulations). Section 106 requires Federal agencies to consider the effects of their actions on historic properties, to assess the effects of the proposed action on the properties, and, if applicable, to find ways to avoid or mitigate adverse effects. Section 106 applies not only to those properties listed on the National Register of Historic Places, but also to properties that meet specified eligibility criteria. This could include properties that have not been listed and even those that have not yet been discovered, especially in the case of archaeological resources.

In Hawaii, Section 106 review is carried out by the Department of Land and Natural Resources. The proposed Waiau-CIP, Part 2 transmission line will be adjacent to the boundary of the Pearl Harbor National Register Historic District and National Historic Landmark. In a 12 May 1992 response to the Draft EIS for Waiau-CIP, Part 2, DLNR concurred that overhead lines are likely to have "no effect" on historic sites.

The section of the proposed action near the Waiau Power Plant is located on unsurveyed land with high potential for cultural resource recovery. Most of the proposed action consists of land that has been previously disturbed by road or building construction. Although the area in its undisturbed state might have had high or medium potential for cultural resource recovery, the likelihood of finding undisturbed resources has been considerably reduced by development. If previously undetected prehistoric or historic sites are found during transmission line pole excavation, construction activity in the site area(s) will stop and the State Historic Preservation Officer will be contacted. Consultations with the State of Hawaii will determine what course of action will be taken. Field personnel involved in project construction will be informed about the potential for uncovering historic and/or prehistoric sites and about the proper procedures to follow if a previously unidentified site is discovered. An archaeologist will be present during all excavation work to monitor for archaeological resources. As a result of the Section 106 process, the State Historic Preservation Office has determined that this project will have "no effect" on historic sites (see Appendix C).

5.13.4.3 *Coastal Zone Management Program*

The National Coastal Zone Management (CZM) Act of 1972 (P.L. 92-583), as amended (P.L. 94-370), requires Federal agencies to conduct their planning, management, development, and regulatory activities in a manner consistent with the State of Hawaii's CZM programs. The "coastal zone" of Hawaii includes all non-federal property within the state, including offshore islands and the submerged lands and waters extending seaward to a distance of three nautical miles. The Office of State Planning, as the lead agency of the CZM Program, is responsible for conducting Federal consistency review for the following:

- Federal activities
- Activities requiring a Federal license or permit
- Federal assistance to local governments

The review to establish consistency with CZM policies as stated in E.O. 78-37, is conducted as specified in 15 CFR Part 930. Because the overall project is located in the coastal zone and overall project activities include a federal action permit or approval, a CZM Program Federal Consistency Approval is required from the Office of State Planning. Following review of the project impacts, CZM determines whether or not the activity is consistent with the objectives and policies of the CZM program. A Federal activity may not occur, nor may a Federal permit be issued prior to issuance of a CZM Determination of Federal Consistency. The Navy and the Hawaii Office of State Planning have determined that the proposed action of granting easements to HECO is consistent with the goals and objectives of the Coastal Zone

Management program. A copy of "Determination of Consistency" form filed with the Hawaii Office of State Planning and OSP's response letter are included in Appendix D.

5.13.4.4 State and County Plans and Policies

The State Land Use Law, the Hawaii State Plan, the State Functional Plan for Energy, and the City and County of Honolulu General Plan, Development Plan, and Land Use Ordinance are the principal local-level guides to community land use plans, policies, and goals on Oahu. The following paragraphs describe how the overall Waiau-CIP, Part 2 Project (including the project area subject to Navy easements) is compatible with these plans, policies, and goals.

State Land Use Law (HRS Chapter 205). Constructing a transmission line is a permitted use in all but the Protective Subzone of the Conservation Land Use District. Neither the preferred nor the 46-kV easement alternative crosses any land in the Conservation Land Use District.

The two build alternatives will be developed within areas designated by the state as part of the Agricultural and Urban Districts. The proposed action will not require any changes to the State's Land Use Boundaries.

Hawaii State Plan (HRS Chapter 226, Revised 1987). The Hawaii State Plan objective that is most directly relevant to the proposed project is Section 226-18, *Objectives and Policies for Facility Systems—Energy/Telecommunications*, which reads as follows:

- (a) Planning for the State's facility systems with regard to energy/telecommunications shall be directed towards the achievement of the following objectives:
 - (1) Dependable, efficient, and economical state-wide energy and telecommunication system capable of supporting the needs of the people.
 - (b) To achieve the energy/telecommunication objectives, it shall be the policy of this State to ensure the provision of adequate, reasonably priced, and dependable power and telecommunication services to accommodate demand.

The two build alternatives support these policies because the principal goal of the Waiau-CIP, Part 2, Project is to ensure the dependable, efficient, and economic provision of electricity to growing demands on Oahu. The no-action alternative will conflict with these policies.

Section 226-18(c)(4) states that:

- (c) To further the energy objectives, it shall be the policy of this State to:

- (4) Ensure that the development or expansion of power systems and sources adequately consider environmental, public health and safety concerns, and resource limitations.

Comprehensive planning and analysis support HECO's development of the overall project. The February 1992 Routing Report and the August 1992 state Final EIS record the environmental, public health, safety, and other resource considerations that are fundamental to the planning of the project, the evaluation of alignment alternatives, and the selection of the preferred alignment.

The February 1992 Routing Report and the August 1992 Final EIS also document that this project complies with Section 226-11(b)(2-4), *Objectives and Policies for the Physical Environment—Land-Based, Shoreline, and Marine Resources*:

- (b) To achieve the land-based, shoreline, and marine resource objectives, it shall be the policy of this State to:
 - (2) Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.
 - (3) Take into account the physical attributes of areas when planning and designing activities and facilities.
 - (4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.

The water-based activities and natural areas along the shorelines were avoided during the route selection process, and existing physical attributes of the study area were considered. For example, existing rights-of-way and linear facilities were considered an opportunity for siting the new line in order to minimize impacts on existing land uses.

State Energy Functional Plan. The State Energy Functional Plan (State of Hawaii, Department of Business, Economic Development and Tourism, 1991) addresses objectives, policies, and implementing actions in the following areas:

- Energy conservation and efficiency
- Alternate and renewable energy
- Energy education
- Legislation
- Integrated energy management
- Energy emergency preparedness

The overall project does not conflict with any of the objectives, policies, and implementing actions of the State Energy Functional Plan, which addresses generation and conservation rather than transmission issues.

State Public Utilities Commission. State Public Utilities Commission authorization under PUC General Order 7 is required for the project because the construction cost exceeds \$500,000. PUC approval is also required for construction of a utility line 46-kV and above within a residential area. The PUC approved HECO's application (Docket 7256) to construct the proposed project in Decision and Order No. 13201, issued April 7, 1994.

City and County of Honolulu General Plan. The General Plan (City and County of Honolulu, Department of General Planning, 1988) most directly pertains to the overall Waiau-CIP, Part 2 Project in Objective C, Policies 1 and 3, of "Transportation and Utilities":

Objective C: To maintain a high level of service for all utilities.

Policy 1: Maintain existing utility systems in order to avoid major breakdowns.

Policy 3: Plan for the timely and orderly expansion of utility systems.

The Waiau-CIP, Part 2, Project is designed to increase the reliability of electric service to existing and future electrical customers, and thus supports this objective of the General Plan.

Objective D, Policy 4, of "Transportation and Utilities" is also relevant to the overall project:

Objective D: To maintain transportation and utility systems that will help Oahu continue to be a desirable place to live and visit.

Policy 4: Evaluate the social, economic, and environmental impact of additions to the transportation and utility systems before they are constructed.

The February 1992 Routing Report and the August 1992 state Final EIS document the extensive analysis of social, economic, and environmental impacts of the preferred and alternative alignments that contributed to the selection of the preferred project alignment.

The General Plan chapter on "Natural Environment" includes several policies related to the overall project:

Objective A: To protect and preserve the natural environment.

All of the preferred alignment is located on developed land. The impacts of the overall project on the natural environment will be minimal.

Objective B of "Natural Environment" addresses scenic views and natural resources:

Objective B: To preserve and enhance the natural monuments and scenic views of Oahu for the benefit of both residents and visitors.

Policy 1: Protect the Island's well-known resources: its mountains and craters; forests and watershed areas; marshes, rivers, streams; shoreline, fish ponds, and bays; and reefs and offshore islands.

Adverse effects on natural resources will be minimal because the build alternatives are located on land that has already been developed and the new line will generally replace or be adjacent to existing 46-kV poles.

Policy 2: Protect Oahu's scenic views, especially those seen from highly developed and heavily traveled areas.

Policy 3: Locate roads, highway, and other public facilities and utilities in areas where they will least obstruct important views of the mountains and the sea.

The Waiau-CIP, Part 2, Project will be located in a highly urbanized area with few scenic or important views of the mountains and the sea. The principal views toward the sea are of Pearl Harbor. Within the study area, however, the shores of Pearl Harbor are largely developed or blocked from views along major roadways by development between the roadways and the shoreline. Potential visual impacts of the overall project are described in Section 5.2 of this environmental assessment.

Objective A of "Physical Development and Urban Design" addresses planning for development:

Objective A: To coordinate changes in the physical environment of Oahu to ensure that all new developments are timely, well designed, and appropriate for the areas in which they will be developed.

Policy 1: Plan for the construction of new public facilities and utilities in the various parts of the island according to the following order or priority: first, in the primary urban center; second, in Ewa; and third, in the urban fringe and rural areas.

The overall project is located in the primary urban center and the purpose of the overall project is to provide reliable electric service to the primary urban center and to the Ewa development plan areas, as well as to other load centers on Oahu.

City and County of Honolulu Development Plan. The overall project does not conflict with any elements of the City and County Development Plan Common Provisions or Special Provisions for the Primary Urban Center. Electric utility facilities that must be listed in the Public Facilities Map are power generation facilities and major substations. Transmission lines with a voltage greater than 46-kV must be listed on the Public Facilities Map unless an application for the project has been filed with the PUC prior to April 1, 1992. An application for this project was filed on March 12, 1992.

City and County of Honolulu Land Use Ordinance. The overall project does not conflict with any elements of the land use ordinance (City and County of Honolulu DLU, 1986). The land use ordinance, which establishes zoning for the city and county, provides for the siting of transmission lines in all land use districts in which the transmission line alignment is located. As the Waiau-CIP, Part 2, Project involves only the construction of transmission lines, with no construction of additional structures or expansion of existing structures, no Conditional Use Permit will be required.

As part of the Hawaii Coastal Zone Management (CZM) program, the City and County of Honolulu DLU designates and administers the SMA along the coast of Oahu. Any "development, the valuation of which exceeds \$65,000 or which may have substantial adverse environmental or ecological effect" (Revised Ordinances of Honolulu, Section 33-1.3) within the designated SMA requires an SMA Use Permit issued by the DLU and approved by the City Council.

A portion of the proposed Waiau-CIP, Part 2 transmission line will be within the SMA boundaries in the vicinity of the Waiau Power Plant. An SMA Use Permit was submitted to DLU on August 28, 1992 and granted by the City & County of Honolulu City Council on February 17, 1993.

5.13.6 Means of Mitigating Potentially Adverse Effects

The proposed granting of easements by the Navy to HECO is not anticipated to have any adverse environmental effects which cannot be avoided or resolved through mitigation. Long-term land use impacts to proposed residential development can be avoided by appropriate setbacks of residential areas from the overhead lines. Short-term impacts to the bike path can be mitigated by maintaining paved areas for bicyclists to use during installation of the poles and conductors. Traffic impacts during construction will be coordinated with the State Department of Transportation and the City and County of Honolulu Department of Transportation Services. Visual clutter will be mitigated through the under-building of lower voltage transmission lines on the 138-kV poles. No species within the easement areas are listed as, or candidates for, endangered or threatened status. An archaeologist will be present during all excavation to monitor for archaeological resources. Should any unexpected archaeological deposits be discovered during excavations, work will stop and the State Historic Preservation Office will be consulted.

Although there is no conclusive evidence of significant health risks from exposure to the electric and magnetic fields of 138-kV transmission lines, the public is concerned about this issue. That concern is being addressed through the use of low-reactance phasing, where feasible, to reduce the electric and magnetic field strengths. Pre- and post-construction measurements of electric magnetic fields will be conducted in consultation with nearby communities.

5.13.7 Adverse Environmental Effects Which Cannot be Avoided and Unresolved Issues

No adverse environmental impacts which cannot be mitigated or issues which cannot be resolved have been identified through the course of this environmental assessment.

Addendum
to
Environmental Assessment for the Granting of U.S. Navy Easements
Near Pearl Harbor and Waikale Gulch, Oahu, Hawaii
to
Hawaiian Electric Company, Inc.
for the
Waiau-Campbell Industrial Park 138-kV Transmission Line, Part 2, Project

5.14 Environmental Justice in Minority Populations and Low-Income Populations

In accordance with Executive Order 12898 dated February 11, 1994, and the Secretary of Navy Notice 5090 dated May 27, 1994, the Navy is required to identify and address, as appropriate, the potential for disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations. The specific requirements of these policies state that the Navy shall:

- Ensure that all programs or activities under its control receiving federal financial assistance and that affect human health or the environment do not directly or indirectly use criteria, methods, or practices that discriminate on the basis of race, color or national origin;
- Analyze the human health, economic, and social effects of its actions, including effects on minority and low-income communities, when such analysis is required under NEPA;
- Ensure that mitigation measures outlined or analyzed in an environmental assessment, environmental impact statement, or record of decision, whenever feasible, address significant and adverse environmental effects of proposed federal actions on minority and low-income communities;
- Ensure that opportunities for community input in the NEPA process are provided, including identifying potential effects and mitigation measures in consultation with affected communities and ensuring accessibility to meetings, crucial documents, and notices; and
- Ensure that the public, including minority and low-income communities, has adequate access to public information relating to human health or environmental planning, regulation, and enforcement.

To provide a demographic frame of reference for this project, census data on family income and race/ethnicity for the areas affected by the proposed transmission line project are provided in Tables 1, 2, and 3. With respect to low-income status (Tables 1 and 2), none of the communities in the project area is a low-income community (that is, has a

median family income that is less than 80% of the State median family income). Table 1 presents income data by "census designated places" (CDPs), which provide an overall view of the communities in the project area. The CDPs are comprised of a group of whole and partial census tracts that together represent a community as defined by the State of Hawaii in cooperation with the U.S. Census Bureau. Table 2 focuses on the specific census tracts through which the transmission lines traverse. Figure 1 illustrates the general configuration and location of the CDPs and census tracts relative to the transmission lines' alignment and the Navy easement areas.

With respect to race (Table 3), the communities (CDPs) in the project area have a majority of non-white populations — a condition that is true for Honolulu County and the State of Hawaii as a whole.

As noted below, the process by which the transmission lines' alignment and easements were selected was conducted in a manner which did not discriminate against low-income populations or racial populations in Hawaii. Moreover, no significant environmental effects from the granting of Navy easements to Hawaiian Electric Company, Inc. (HECO) have been identified.

In proposing to grant easements to HECO, the Navy has not directly or indirectly used criteria, methods, or practices that discriminate on the basis of low-income status or race. During the course of its public evidentiary hearing on HECO's application to construct the transmission lines, the Hawaii Public Utilities Commission heard testimony on the issue of social equity before approving HECO's application. In its Decision and Order (D&O) No. 13201, issued April 7, 1994, the Commission considered community concerns that HECO's proposed H-1 overhead transmission lines' alignment would cause west Oahu residents and businesses to bear a disproportionate share of the negative impacts of the lines as a result of their proximity to the lines and that placing the lines underground would be an appropriate step in achieving social equity for the residents of west Oahu. In its D&O (pages 30-31), the Commission reaffirmed its position from an earlier application that the disproportionate number of transmission lines in any one district does not justify the underground placement of additional transmission lines traversing the district. The Commission concluded that the social inequity argument had not been adequately supported and that it, therefore, would not order HECO to place the Waiau-CIP Part 2 transmission lines underground for social equity reasons.

The Navy's decision to grant the easements to HECO are based on analyses of the potential human health, economic, and social effects of the proposed project on all persons regardless of income level or race. During the course of obtaining approvals for the project, mitigation measures were required as conditions to the approvals. These analyses and conditions are documented in the public record by the Hawaii Public Utilities Commission, the Hawaii Office of Environmental Quality Control, and the City and County of Honolulu.

The Navy has ensured that opportunities for community input in the project's route selection process and environmental review have been provided. The Navy and HECO did not discriminate against any community on the basis of low-income status or race. As documented in the EA, extensive public involvement activities were conducted throughout all the affected communities during the route selection and environmental review processes. Community concerns were addressed.

The public has had adequate access to information concerning the project. Several documents (Route Selection Study, State EIS, and newsletters) were issued to the general public. Public notices on the availability of the State EIS were published in newspapers of general circulation. Copies of reports were sent to public libraries. References cited in these reports are available for public review. Permits and approvals listed in the EA are available for public review at the appropriate government agency.

Table 1
Census Designated Places (CDPs) in Transmission Lines' Project Area:
Median Family Income and Low-Income Status

CDP	Median Family Income ¹	Above/below (+/-) 80% of State median ²
Pearl City	\$52,879	+
Village Park	\$56,880	+
Waimalu	\$56,359	+
Waipahu	\$40,635	+
Waipio	\$53,916	+

Table 2
Specific Census Tracts (CTs) Traversed by Transmission Lines:
Median Family Income and Low-Income Status

CT	Median Family Income ³	Above/below (+/-) 80% of State median ²
80.01	\$37,100	+
80.02	\$47,917	+
80.03	\$31,633	+
86.03 ⁴	\$48,642	+
86.98 ⁴	\$45,946	+
89.05	\$56,672	+
89.11 ⁵	\$53,937	+

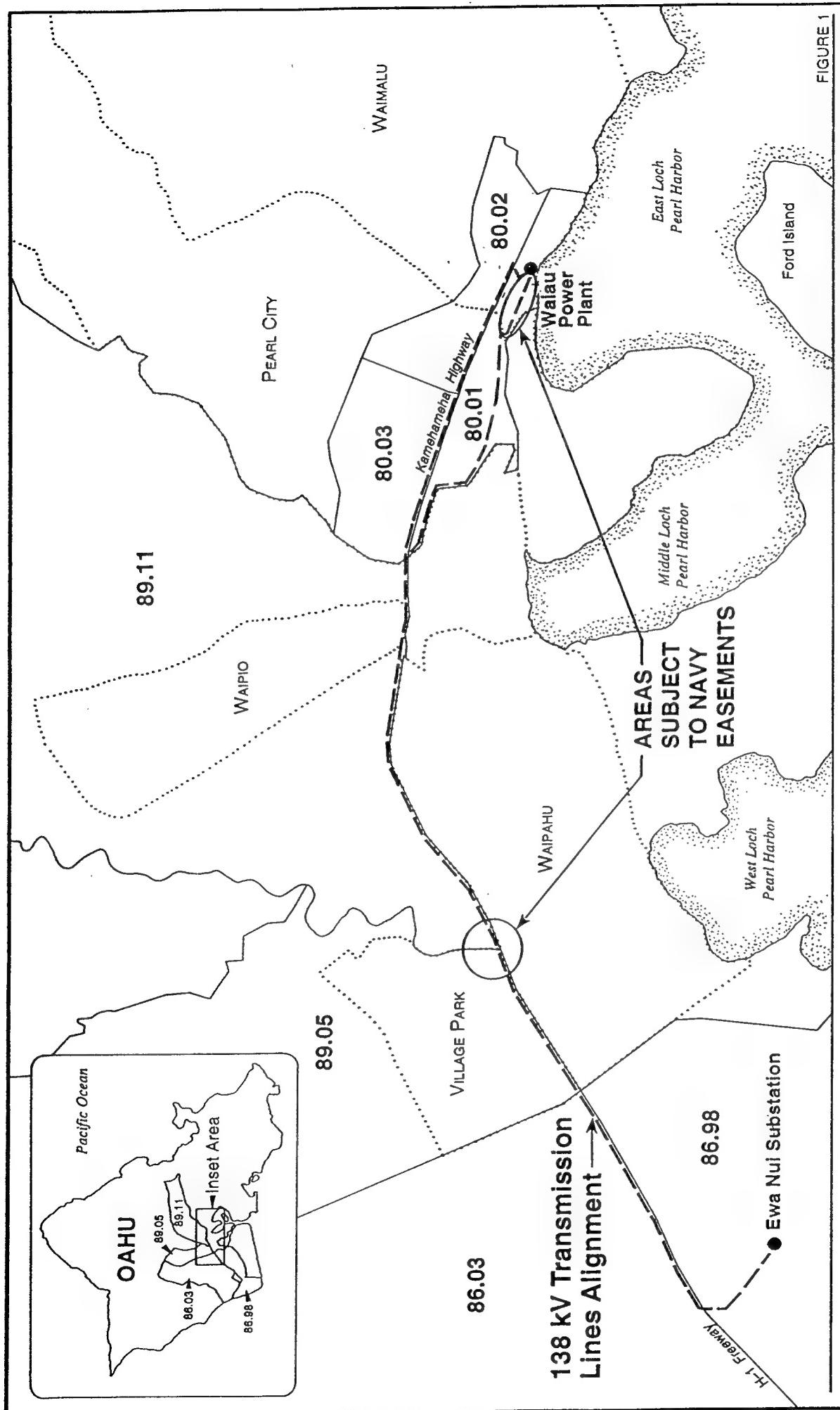
Footnotes:

- 1 Sources: 1990 Census of Population Social and Economic Characteristics Hawaii
- 2 Based on HUD Notice PDR-95-02 defining low income as 80% of state median family income ($\$38,829 \times .8 = \$31,063$ for 1990)
- 3 Sources: Hawaii State Data Center Report No. 8: General Social & Economic Characteristics for the State of Hawaii: 1990
- 4 The transmission lines traverse unpopulated areas included in census tracts 86.03 and 86.98.
- 5 This census tract includes a new planned development known as "Waikeli" which did not exist at the time of the census.

Table 3
Race and Ethnicity by Census Designated Place in the
Project Area, Honolulu County, and State

	Pearl City	Village Park	Waimalu	Waipahu	Waipio	Honolulu County	State
Total Population	30,993	7,407	29,967	31,435	11,812	836,231	1,108,229
White	6,617	1,630	8,434	3,634	3,405	264,767	370,270
Percent of total population	21%	22%	28%	12%	29%	32%	33%
Black	861	114	740	619	357	25,711	26,669
Percent of total population	3%	2%	2%	2%	3%	3%	2%
American Indian, Eskimo, or Aleut	181	17	170	149	40	3,954	5,596
Percent of total population	1%	0%	1%	0%	0%	0%	1%
Asian or Pacific Islander	22,820	5,510	20,382	26,340	7,847	527,410	686,391
Percent of total population	74%	74%	68%	84%	66%	63%	62%
Other race	514	136	241	693	163	14,389	19,303
Percent of total population	2%	2%	1%	2%	1%	2%	2%
Hispanic origin (of any race)	2,042	653	1,771	3,626	671	54,680	78,742
Percent of total population	7%	9%	6%	12%	6%	7%	7%

Source: 1990 Census of Population Social and Economic Characteristics Hawaii



Chapter 6

List of Preparers

A. Hawaiian Electric Company, Inc.:

Patrick A. Calizar, Senior Civil/Structural Engineer, Structural Section, Transmission Systems Division

Francis K. Hirakami, Senior Electrical Engineer, Transmission Section

Ken T. Morikami, Project Manager, Project Management Division, Facilities and Project Management Department

B. CH2M HILL:

Paul Luersen, Project Manager, Senior Reviewer, Environmental Planner

Mark Willey, Assistant Project Manager, Environmental Planner

Jane Hart, Environmental Planner

Clyde Kanehiro, Cartographer, Graphics

Mara Soloway, Project Assistant

Ann Shankland, Document Editor-Production Manager

C. U.S. Navy, Pacific Division, Facilities Engineering Command Coordination Team:

Melvin Kaku, P.E., Director, Environmental Planning Division, Facilities Planning and Real Estate Department, Code 23 (Supervisory, environmental planning)

Stanley Uehara, P.E., Environmental Planning Division, Facilities Planning and Real Estate Department, Code 232 (Scoping and content)

D. Preparers of Technical Studies and the Routing Report (February 1992) and State FEIS (August 1992) on which this document is based:

Winona Char, Char and Associates: Biological assessment

Clyde Kanehiro, Cartographer, CH2M HILL: Mapping and graphics

Joseph Kennedy, Archaeological Consultants of Hawaii, Inc.: Cultural resource analysis

Leslie Howell, Environmental Planner, CH2M HILL: Assistant Project Manager

Paul Luersen, Environmental Planner, CH2M HILL: Project Manager

Tom Packard, Planner, EDAW: Visual simulations

Brent Schulz, Planner, CH2M HILL: Land use analysis, mapping and graphics

Mike Silva, P.E., Principal, Enertech Consultants: Electric and magnetic field measurements and analysis

Bob Wong, P.E., Geolabs, Hawaii, Inc.: Geotechnical analysis

Eric Zigas, Senior Planner, EDAW: Visual simulations and visual impacts analysis

Chapter 7

Bibliography

Advisory Council on Historic Preservation, U.S. Navy, and the State Historic Preservation Office. September 1979. Memorandum of Agreement between the U.S. Navy and the Advisory Council on Historic Preservation regarding Pearl Harbor National Historic Landmark.

American National Standards Institute. 1987. *National Electrical Safety Code*. ANSI C2-1987.

Carnegie Mellon University. May 1989. *Biological Effects of Power Frequency Electric and Magnetic Fields—Background Paper*. OTA-BP-E-53. Washington, D.C.: U.S. Government Printing Office. Prepared for Office of Technology Assessment, U.S. Congress.

Carstensen, E. L. 1985. *Biological Effects of Transmission Line Fields*. New York: Elsevier Press.

CH2M HILL. October 1991. *Routing Report: Waiau-Campbell Industrial Park 138 kV Transmission Line/Part 1—CIP to Ewa Nui Substations*. Oahu, Hawaii. Prepared for Hawaiian Electric Company.

CH2M HILL. February 1992. *Routing Report: Waiau-Campbell Industrial Park 138 kV Transmission Line/Part 2—Ewa Nui Substation to Waiau Power Plant*. Oahu, Hawaii. Prepared for Hawaiian Electric Company.

CH2M HILL. August 1992. *Final Environmental Impact Statement: Waiau-Campbell Industrial Park 138 kV Transmission Line Project/Part 2—Ewa Nui Substation to Waiau Power Plant*. Oahu, Hawaii. Prepared for Hawaiian Electric Company.

CH2M HILL. February 1993. *Final Environmental Assessment: Waiau-Campbell Industrial Park 138 kV Transmission Line/Part 1—CIP to Ewa Nui Substations*. Oahu, Hawaii. Prepared for Hawaiian Electric Company.

City and County of Honolulu, Department of General Planning. 1988. *Honolulu General Plan*.

City and County of Honolulu, Department of Land Utilization. 1987. *Coastal View Study*.

Department of the Navy. 1978. *Historic Preservation Plan, U.S. Naval Base, Pearl Harbor National Historic Landmark*. Honolulu, Hawaii.

EMF Health & Safety Digest. Volume II, No. 4 (April, 1993); No. 5 (May, 1993); No. 8 (September, 1993).

EMF News. Volume 3, No. 10 (May 24, 1993); No. 15 (August 16, 1993); No. 16 (September 6, 1993).

Enertech Consultants. 1985. *AC Field Exposure Study: Human Exposure to 60 Hz Electric Fields*, EPRI Report EA-3993.

Enertech Consultants. 1992. *Technical Information Paper on Transmission Line Electrical Effects*.

Environmental Protection Agency, Science Advisory Board, Radiation Advisory Committee, Nonionizing Electric and Magnetic Fields Subcommittee. *Potential Carcinogenicity of Electromagnetic Fields*. 1992.

Environmental Protection Agency. *Questions and Answers About Electric and Magnetic Fields (EMF)*. December, 1992.

Gauger, J. R. 1985. "Household Appliance Magnetic Field Survey." *IEEE Transactions on Power Apparatus and Systems*. Vol. PAS-104, No. 9:2436-44.

Gulliver, John W. and Vito, Christine C. "EMF and Transmission Line Siting: The Emerging State Regulatory Framework and Implications for Utilities." NR&E. Winter, 1993.

Hawaiian Electric Company, Inc. 1993. *Integrated Resources Planning 1994 to 2013*. Honolulu, Hawaii.

Illinois Technology Research Institute. 1979. *The Effects of 60 Hz Electric and Magnetic Fields on Implanted Cardiac Pacemakers*. EPRI Report EA-1174.

International Commission on Non-ionizing Radiation Protection. Press release announcing confirmation of 1990 interim guidelines. May 12, 1993.

International Radiation Protection Association, International Nonionizing Radiation Committee. "Interim Guidelines on Limits of Exposure to 50/60-Hz Electric and Magnetic Fields." Published in *Health Physics*, January 1990.

Kanai, W., U.S. Army Corps of Engineers. Personal communication, September 29, 1989.

National Radiological Protection Board, Advisory Group on Non-ionizing Radiation. *Electromagnetic Fields and the Risk of Cancer*. NRPB Document Volume 3, No. 1, 1992.

Naughton, John. Personal communication, February 6, 1992.

New York State Power Lines Project. 1987. *Biological Effects of Power Line Fields*. Scientific Advisory Panel Final Report.

Oak Ridge Associated Universities, Panel for the Committee on Interagency Radiation Research and Policy Coordination. *Health Effects of Low-Frequency Electric and Magnetic Fields*. June, 1992.

Power Delivery Consultants, Inc. *Magnetic Field Calculations for Hawaiian Electric Company Waiau-CIP 138 kV Transmission Line Project*. (for high-pressure, fluid-filled pipe-type underground cables). July 15, 1993.

Silva, J. M. 1988. "Power Frequency Magnetic Fields in the Home." Paper No. 88WM101-8: Presented at the 1988 IEEE/PES Winter Power Meeting, New York.

Slesin, Louis; Connelly, Mathew and Bergman, David. *Electromagnetic Fields and Land Use Controls*. American Planning Association, Planning Advisory Service Report No 435, December, 1991.

State of Hawaii. 1991. *Traffic Summary for the Island of Oahu*. Department of Transportation. Honolulu, Hawaii.

State of Hawaii Department of Health. Comment letter of March 10, 1993 on Final EIS for Waiau-CIP Part 2 Transmission Lines Project.

State of Hawaii Department of Health. "DOH Policy Relating to Electric and Magnetic Fields from Power Frequency Sources." January 19, 1994.

State of Hawaii Public Utilities Commission, Docket 7256. Various exhibits and testimony presented before the Commission concerning the Waiau-CIP Part 2 Transmission Lines Project. 1993.

State of Hawaii Public Utilities Commission, Decision and Order No. 13201. Approval of Waiau-CIP 138 kV Transmission Lines, Part 2, Project based on record in Docket 7256. April 7, 1994.

Stone and Webster Management Consultants, Inc. February 1984. Hawaiian Electric Company Investigation of July 13, 1983, Blackout.

Sumida, H., Department of Transportation Highways Division. Personal communication. March 1988.

Tomlinson, M. J. 1977. *Pile Design and Construction Practice*. Cement and Concrete Association, London.

University of Rochester. 1985. *Evaluation of the Effects of Electric Fields on Implanted Cardiac Pacemakers*. EPRI Report EA-3917.

Appendix A

U.S. Army Corps of Engineers Consultation

CONSTPR 8430
YA/G



March 23, 1994

Ms. Susan Baba
U. S. Army Corps of Engineers, Pacific Ocean Division
CEPOD-CO-O
Building T-1
Fort Shafter, Hawaii 96858-5440

Dear Ms. Baba:

Subject: Waiau-CIP 138 kV Lines Part 2, Corps Section 10 and Section 404 Permits

We are in the process of finalizing our designs and obtaining the required permits for the construction of our proposed Waiau-CIP 138 kV Line Part 2 project. The alignment is from Ewa Nui Substation to Waiau Power Plant is shown on the attached Figure. It will consist of the following elements;

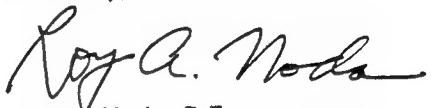
- Double-circuit overhead line that follows the existing 46 kV easement mauka of the Ewa Nui Substation along a cane haul road and crosses to the mauka side of H-1; then eastward along the mauka edge of the H-1 right-of way to the Kunia Road/H-1 Interchange; then through the interchange to follow the existing 46 kV easement between H-1 and a cane haulroad to Waikele Gulch. The existing 46 kV lines would be underbuilt.
- Double-circuit overhead line that spans Waikele Gulch to a point between H-1 and a new drainage ditch; then along H-1 through Waikele Gulch to the vicinity of the new Waipiolani Substation at the H-1/H-2 Interchange.
- From the vicinity of the existing Waipiolani Substation, the alignment would follow an existing 46 kV easement to the Pearl City Industrial Park. The Existing 46 kV lines would be underbuilt.
- From the Pearl City Industrial Park to the Waiau Power Plant, the H-1 overhead alignment has two single-circuit overhead lines that generally follow existing 46 kV easements:
 1. Single-circuit overhead line that follows a 46 kV easement along the makai side of Kamehameha Highway to a point between H-1 and the power plant; from that point the line backtracks along HECO property to join the 46 kV easement from the OR&L. The 46 kV lines would be underbuilt. The existing 12 kV line along the makai side of Kamehameha Highway would be placed underground.
 2. Single-circuit overhead line that crosses Kamehameha Highway to an existing 46 kV easement along Waiawa Stream to the University of Hawaii's Extension Program experimental station; then along 2nd Street mauka of H-1 to a point east of Lahua Avenue; then follows the existing easement to the power plant. The two single-circuit alignments would become a double-circuit alignment near the diesel tanks at the power plant. The existing 46 kV and 12 kV lines would be underbuilt.

Our consultant, Mr. Jim Rogers of the Stone and Webster Engineering Corporation, has been in contact with you to discuss the requirements for a Section 10 and Section 404 permit for the segment of this line that crosses Waiawa Stream and Waikele Stream. Based on our conversations

with Mr. Rogers, it is our understanding that the Corps of Engineers has determined that there is no requirement for a Section 10 or Section 404 permit for this section of the transmission line since construction will not obstruct or alter navigable waters and will not discharge any dredged or fill material into waters or wetlands.

We would appreciate a letter from the Corps confirming this decision. Since this line is required to increase the reliability of our system, we are fast tracking its construction. As a result, we would appreciate your response by April 15, 1994. Thank you for your time in reviewing this project as it relates to the regulatory authorities and responsibilities of the Corps of Engineers. Please contact Clinton Char at (808) 543-7913 should you have any further questions on this project.

Sincerely,

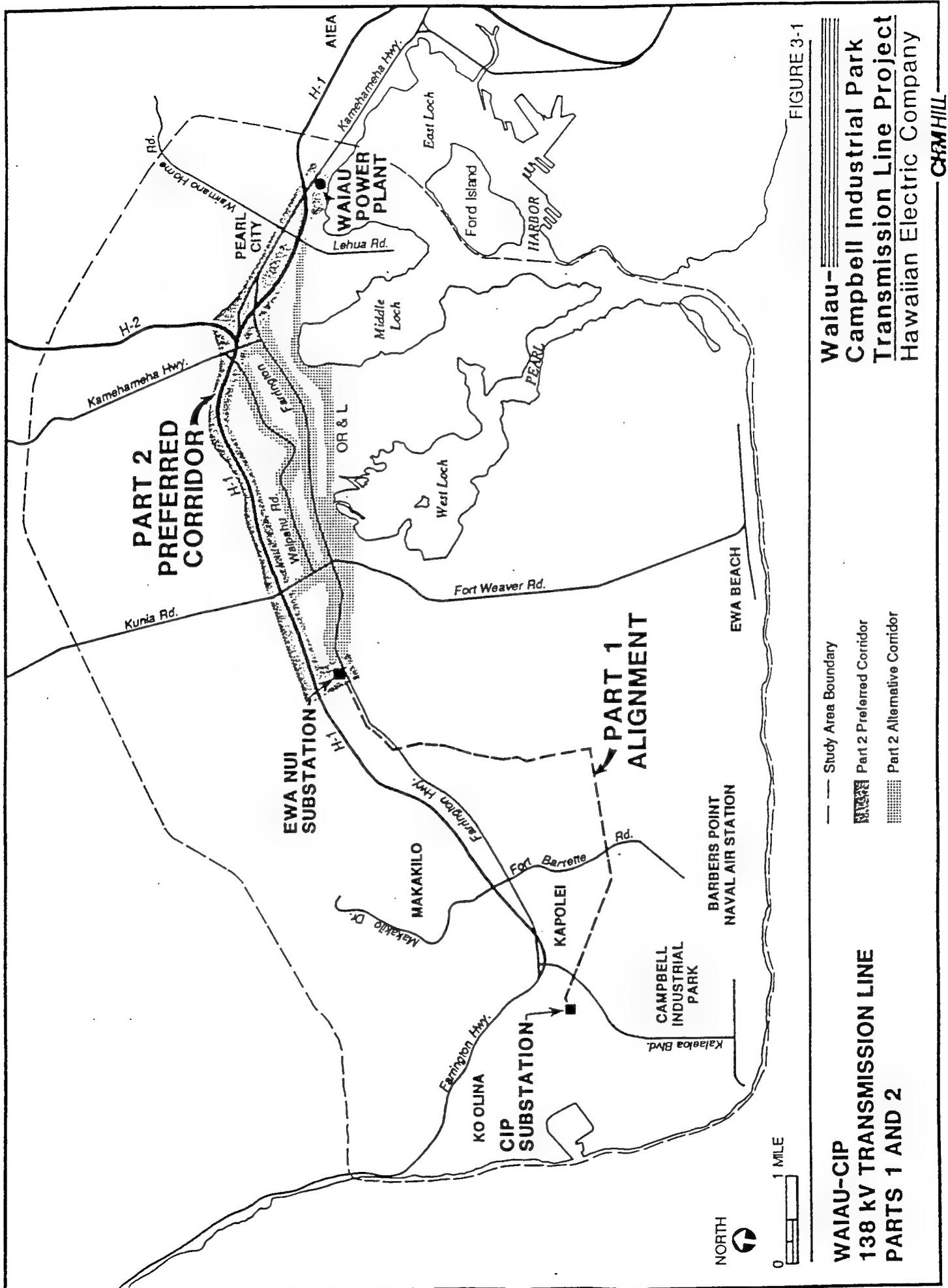


Roy A. Noda, P.E.
Senior Civil/Structural Engineer

CYC
Enclosures

cc: K. Morikami
J. Rogers, SWEC





DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FORT SHAFTER, HAWAII 96858-5440

April 21, 1994

REPLY TO
ATTENTION OF

Operations Division

SUBJECT: Waiau-CIP 138 KV Lines Part 2, Oahu, Hawaii,
File No. NP94-067

Mr. Roy A. Noda, P.E.
Hawaiian Electric Company, Inc.
P.O. Box 2750
Honolulu, Hawaii 96840-0001

Dear Mr. Noda:

This is in response to your letter dated March 31, 1994, regarding the subject project.

The proposed Waiau-CIP 138 kV power lines part two will begin at the Ewa Nui Substation and end at the Waiau Power Plant. Along this route, various streams will be crossed: Waikale Stream, Panakauahi Stream, Waiawa Stream and an unnamed stream. The power lines will span all the streams. The proposed route does not cross navigable waters. As a result, no fill will be placed into waters of the United States and no work or structures will affect navigable waters.

There is an existing wetland southwest of the Waiau Power Plant in which the existing power lines is routed. Mr. Rogers informed Ms. Baba that the line through this wetland will be pulled. The existing poles will be cut and removed by helicopter. There will be no placement of fill and no heavy equipment in this wetland. This removal plan is a condition of HECo's Special Management Area permit. As such, the removal plan must not be deviated from.

Mr. Clinton Char, of your staff; Mr. Jim Rogers, your consultant; Ms. Ruby Mizue and Ms. Suzanne Baba, of my staff walked the proposed route. They encountered no wetlands along the proposed route.

Based on the information provided, on office information, on discussions with Mr. Rogers, and on the site visit, no Department of the Army permit is required for the subject project.

If you have any questions, please contact Ms. Baba at

-2-

438-9258 extension 17. Please refer to File No. NP94-067 on
any future correspondence regarding this matter.

Sincerely,

Warren Kau
for Michael T. Lee
Chief, Operations Division

Copies Furnished:

Clean Water Branch, Env. Management Division, Hawaii State
Department of Health, 919 Ala Moana Boulevard, 3rd Floor,
Honolulu, Hawaii 96814
Director, Office of State Planning, Coastal Zone Management
Program, Office of the Governor, P.O. Box 3540, Honolulu,
Hawaii 96811-3540

Appendix B

U.S. Fish and Wildlife Section 7 Consultation

5090(P)
Ser 232/

9 JUN 1994

Mr. Robert Smith
Field Supervisor
Pacific Islands Office
U.S. Fish and Wildlife Service
P.O. Box 50167
Honolulu, HI 96850

Dear Mr. Smith:

The Navy, in compliance with 50 CFR 17, Section 402 requests entering into an informal Section 7 consultation with your office regarding a proposed action by the Navy to grant easements to Hawaiian Electric Company (HECO) for the use of Navy property. As described below, the Navy is planning to grant easements for HECO's Waiau-Campbell Industrial Park 138-kV Transmission Line, Part 2, Project.

HECO's request is to install, operate, and maintain steel transmission line poles, conductors, and/or guy poles, wire and anchors along three specific areas, subject to Navy easements, of the proposed alignment for the project. Navy easements are required inland of the H-1 freeway in the vicinity of Waikale Gulch to allow conductors to span the gulch, on the Pearl City Peninsula adjacent to the existing bikepath and state energy corridor, and near the Waiau Power Plant seaward of the H-1 freeway.

The wildlife occurring in the urbanized areas consist primarily of introduced species. Of the few undeveloped lands remaining, only the wetlands provide habitat for any significant populations of native wildlife. The Waiawa Unit of the Pearl Harbor National Wildlife Refuge, located 1.5 miles west of Waiau Power Plant, is designated by the U. S. Fish and Wildlife Service (USFWS) as an "Essential Habitat" for the survival of four endemic species of waterfowl, all of which are on the federal and state endangered lists. These species are the Black-necked Stilt or Ae'o (*Himantopus mexicanus knudseni*), the Moorhen or 'Alae-'Ula (*Gallinula chloropus sandvicensis*), the American Coot or 'Alae-Ke'oke'o (*Fulica americana alai*), and the Koloa (*Anas wyvilliana*). Other wetlands, including those at the power plant as well as riparian areas, irrigation ditches, and ponds, are also used by these species, but to a lesser degree. A bird that occurs sporadically throughout the project area in undeveloped and agricultural lands is the Short-Eared Owl (or Pueo). It is on the state endangered list for Oahu only. No endangered, threatened, or sensitive marine or freshwater fish species are known to exist in the project area.

The four endemic species of waterfowl mentioned above have been known to use the wetland areas near the Waiau Power Plant. There is some concern that the proposed transmission line poles will stand taller than other poles and trees in the area. However, the probability of endangered species flying into the transmission lines is very low because the poles will be adjacent to the H-1 viaduct and within the built section of the Waiau Power Plant where numerous tall structures and power lines already exist. No significant adverse impact to wildlife is expected.

The most significant and least disturbed vegetation within the overall study area occurs in the wetlands along the shores of the East Loch of Pearl Harbor. The nonwoody wetlands community is composed of various members of the sedge family (Cyperaceae), cattails (*Typha latifolia*), and pickleweed (*Batis maritima*). Nonwoody wetlands occur in an area adjacent to the Waiau Power Plant. This area provides important habitat for the four endangered species of waterfowl mentioned above. A Special Management Area (SMA) designation

ENCLOSURE(3)

protects nonwoody wetland communities as valuable coastal resources. The SMA includes lands inland and seaward of the Oahu Railway & Land (OR&L) right-of-way along Pearl Harbor and that portion of the overhead transmission lines that connect to the Waiau Power Plant.

Other, less significant cultivated wetlands occur in a small area inside the Waiau Power Plant property. Cultivated wetland crops include watercress (*Nasturtium microphyllum*), taro (*Colocasia esculenta*), and ung-choi (*Ipomoea aquatica*).

No plant species identified in the study area have been listed by the USFWS as threatened or endangered. Similarly, no special-status plant species or sensitive plant communities have been identified by the State of Hawaii.

Nonwoody and cultivated wetlands located in a SMA near and in the Waiau Power Plant site will be avoided during construction associated with the proposed alignment in that area. Poles will be placed to span wetlands, and will be reached through nonwetland areas for maintenance.

Under the proposed project, existing 46 kV lines in a wetland area will be relocated to the proposed steel poles along the bike path. The remaining wooden poles in the wetland areas will be removed by cutting the poles to grade and removing them by helicopter or by other means without driving equipment in the wetland area. This will cause minimal impact to the existing wetlands.

The proposed action is required because the areas subject to Navy easements are integral to the entire 7.8-mile Waiau-Campbell Industrial Park 138-kV Transmission Line, Part 2, Project. The Part 2 Project is the eastern portion of a new transmission line system that will interconnect the Campbell Industrial Park (CIP) substation with the Waiau Power Plant. The western portion of the system is called the Waiau-CIP 138-kV Transmission Line, Part 1, Project. Both Part 1 and Part 2 are needed to meet transmission requirements for new power generation projects located in CIP and to improve islandwide transmission system reliability.

HECO has received state and county approvals as follows:

1. The Hawaii Public Utilities Commission approved HECO's request to construct the project in Decision and Order No. 13201 issued April 7, 1994.
2. A SMA Use Permit was granted for the project by the City & County of Honolulu by Resolution No. 92-307 adopted by the City Council on February 17, 1993.
3. The project's Final Environmental Impact Statement (EIS), prepared pursuant to the state's EIS rules, was accepted by the State Department of Transportation on August 26, 1992.

Enclosed for your review is a revised draft environmental assessment (EA), dated May 6, 1994. This EA is prepared pursuant to the National Environmental Policy Act (NEPA) and Navy regulations (OPNAVINST 5090.1A). The EA's discussion of biological resources is largely based on the state EIS. Biological resources discussions in the federal EA are found in sections 4.4 and 5.4.

Also enclosed for your reference is a copy of the "Biological Resources Survey," dated October 1988, prepared by Char and Associates. This technical

5090(P)
Ser 232/

report was prepared as part of the route selection process for Part 1 and Part 2 and appears as Appendix E to "Routing Report on Waiau-Campbell Industrial Part 138-kV Transmission Line: Part 2 - Ewa Nui Substation to Waiau Power Plant." During the route selection process, HECO and its consultant, CH2M HILL, consulted with Mr. Jerry Leinecke concerning potential impacts of transmission line alternatives.

If you have any questions, please call Mr. Dan Moriarity (Code 237), Navy Natural Resources Specialist at 471-9338 or by facsimile transmission at 474-4890.

Sincerely,

RALPH T. KANESHIRO
Director
Environmental Planning Division
Acting

Encl:

- (1) Revised Draft
Environmental Assessment
for the Granting of U.S. Navy
Easements Near Pearl Harbor
and Waikale Gulch, Oahu,
Hawaii of May 6, 1994
- (2) Biological Resources
Survey of October 1988



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Ecoregion
300 Ala Moana Blvd, Room 6307
P.O. Box 50167
Honolulu, Hawaii 96850

In Reply Refer To: MWR

AUG 26 1994

Mr. Ralph T. Kaneshiro
Director, Environmental Planning Division
Department of the Navy
Naval Facilities Engineering Command
Pearl Harbor, Hawaii 96860-7300

Re: Revised Draft Environmental Assessment for the Granting of U.S. Navy Easements to Hawaiian Electric Company, Inc. for the Waiau-Campbell Industrial Park

Dear Mr. Kaneshiro:

The U.S. Fish and Wildlife Service (Service) has reviewed the May 1994 Revised Draft Environmental Assessment (DEA) for the above-referenced project. The following comments are provided for your consideration pursuant to the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*; 83 Stat. 852), as amended, the Fish and Wildlife Coordination Act of 1934 (16 U.S.C. 661 *et seq.*; 48 Stat. 401), as amended, the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*; 87 Stat. 884), as amended, and other authorities mandating Service concern for environmental values.

The proposed action involves the Navy granting three easements to Hawaiian Electric Company (HECO) for the use of Navy property for HECO's Waiau-Campbell Industrial Park 138-kV Transmission Line. HECO proposes to install, operate, and maintain steel transmission line poles, conductors, and/or guy poles, wires and anchors on Navy property in the vicinity of the Waikale Gulch, Pearl City Peninsula, and the Waiau Power Plant.

The Revised DEA adequately describes the existing environmental conditions of the three proposed easements and potential impacts to fish and wildlife resources. No threatened or endangered plants or marine or freshwater organisms occur within or adjacent to the proposed easements. The Waiawa Unit of the Pearl Harbor National Wildlife Refuge, which is located approximately 2.0 kilometers (1.25 miles) west of the proposed easement near the Waiau Power Plant, is designated as "Essential Habitat" for the survival of four endangered native waterbirds; the Hawaiian Stilt (*Himantopus mexicanus knudseni*), the Hawaiian Moorhen (*Gallinula chloropus sandvicensis*), the Hawaiian Coot (*Fulica americana alai*), and the Hawaiian Duck (*Anas wyvilliana*). It is highly unlikely that any of these endangered waterbirds would fly into the new and taller transmission lines given their proposed location adjacent to the H-1 viaduct in an area where numerous tall structures and power lines already exist.

Based on the above information, the Service will concur with the Navy's determination that no significant adverse impacts to fish and wildlife resources, including endangered and threatened species, will occur. The Service will also support a Finding of No Significant Impact determination for the proposed action.

The Service appreciates the opportunity to provide these comments. If you have any questions regarding these comments, please contact Fish and Wildlife Biologist Michael Ritter at 541-3441.

Sincerely,

Brooks Harper

Brooks Harper
Field Supervisor
Ecological Services

Appendix C

Section 106 Consultation

5090(P)
Ser 232/

4 7 JUN 1994

Mr. Keith Ahue
State Historic Preservation Officer
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

Dear Mr. Ahue:

The Navy is planning to grant easements to Hawaiian Electric Company (HECO) for HECO's Waiau-Campbell Industrial Park 138-kV Transmission Line, Part 2, Project. HECO has requested use of Navy property to install, operate, and maintain steel transmission line poles, conductors, and/or guy poles, wire and anchors along three specific areas of the proposed alignment for the subject project. Navy easements are required inland of the H-1 freeway in the vicinity of Waikale Gulch to allow conductors to span the gulch, on the Pearl City Peninsula adjacent to the existing bikepath and state energy corridor, and near the Waiau Power Plant seaward of the H-1 freeway.

The proposed action is required because the areas subject to U.S. Navy easements are integral to the entire 7.8-mile Waiau-Campbell Industrial Park 138-kV Transmission Line, Part 2, Project. The Part 2 Project is the eastern portion of a new transmission line system that will interconnect the Campbell Industrial Park (CIP) substation with the Waiau Power Plant. The western portion of the system called the Waiau-CIP 138-kV Transmission Line, Part 1, Project. The Part 1 Project which was considered by the Navy under a separate aerial easement request, affects Navy property at an overhead crossing at the Naval Air Station Barbers Point main gate area. Both Part 1 and Part 2 are needed to meet transmission requirements for new power generation projects located in CIP and to improve islandwide transmission system reliability.

HECO has received state and county approvals as follows:

1. The Hawaii Public Utilities Commission approved HECO's request to construct the project in Decision and Order No. 13201 issued April 7, 1994.
2. A Special Management Area Use Permit was granted for the project by the City & County of Honolulu by Resolution No. 92-307 adopted by the City Council on February 17, 1993.
3. The project's Final Environmental Impact Statement (EIS), prepared pursuant to the state's EIS rules, was accepted by the State Department of Transportation on August 26, 1992.

The Department of Land and Natural Resources (DLNR) reviewed the state EIS and the comment by the Historic Preservation Division was that it concurred with the determination in the report that overhead lines are likely to have "no effect" on historic sites, including human burials. A copy of DLNR's comment letter to the state Draft EIS is attached for your reference. Also enclosed for your reference is a copy of the "Cultural Resources Technical Report," dated October 1988, prepared by Archaeological Consultants of Hawaii. This technical report was prepared as part of the route selection process for Part 1 and Part 2 and appears as Appendix F to "Routing Report on Waiau-Campbell Industrial Part 138-kV Transmission Line: Part 2 - Ewa Nui Substation to Waiau Power Plant."

ENCLOSURE(2)

5090(P)
Ser 232/

Based on the information provided by HECO, the Navy has determined that the granting of Navy easements for the Part 2, Project would have no effect on historic and cultural resources. Enclosed for your review is a revised draft environmental assessment (EA), dated May 6, 1994, for the proposed Navy action to grant easements. This EA is prepared pursuant to the National Environmental Policy Act (NEPA) and Navy regulations (OPNAVINST 5090.1A). The EA's discussion of historic and cultural resources is largely based on the state EIS. Cultural and historic discussions are found in sections 4.11 and 5.11.

In compliance with Section 106 of the National Historic Preservation Act, we solicit your concurrence on our determination of "no effect."

If you have any questions, please contact Ms. Anne Griffin (Code 233), Navy Archaeologist, at 471-9338 or by facsimile transmission at 474-4890.

Sincerely,

RALPH T. KANESHIRO
Director
Environmental Planning Division

Encl:

- (1) DLNR ltr OCEA:SKK
File No. 92-631
Doc. ID. 677
of May 12, 1992
- (2) Phase I: Cultural Resources
Technical Report and Phase II
Field Survey Report
of October, 1988
- (3) Revised Draft EA for the
Granting of U.S. Navy Easements
of May 6, 1994



DEPUTIES

JOHN P. KEPPELER II
DONALD L. HANAIKE

AQUACULTURE DEVELOPMENT
PROGRAM

AQUATIC RESOURCES
CONSERVATION AND

ENVIRONMENTAL AFFAIRS
CONSERVATION AND
RESOURCES ENFORCEMENT

CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

June 30, 1994

Ralph T. Kaneshiro, Director
Environmental Planning Division
Department of the Navy
Pacific Division
Naval Facilities Engineering Command
Pearl Harbor, Hawaii 96860-7300

LOG NO: 12072
DOC NO: 9406EJ29

Dear Mr. Kaneshiro:

SUBJECT: Section 106 Review--Revised Draft Environmental Assessment (DEA): HE CO Waiau-Campbell Industrial Park 138 KV Transmission Line, Part 2
(Ref. 5090(P) Ser 232/4140)
Waikale, 'Ewa, O'ahu
TMK: 9-4-02:012
Waiawa-Waiau, 'Ewa, O'ahu
TMK: 9-7-18:003; :010; :020; 9-8-03:033; 9-8-04:016

Thank you for the opportunity to review the Revised DEA for this project which proposes granting of easements to Hawaiian Electric Company (HECO) for installation and operation of the Waiau-Campbell Industrial Park 138 kv Transmission Line. The revised DEA correctly reflects our determination that the project will have "no effect" on historic sites.

Very truly yours,

Keith W. Ahue, Chairperson and
State Historic Preservation Officer

EJ: rn

Appendix D

Coastal Zone Management Determination

5090(P)
Ser 232/

06 JUN 1994

Mr. Harold S. Masumoto
Director, Office of State Planning
Office of the Governor
State of Hawaii
P.O. Box 3540
Honolulu, HI 96811-3540

Dear Mr. Masumoto:

The Navy proposes to grant easements to Hawaiian Electric Company, Inc. (HECO) for use of Navy property. HECO has requested easements to install, operate, and maintain steel transmission line poles, conductors, and/or guy poles, wire and anchors along three specific areas of the proposed alignment for the Waiau-Campbell Industrial Park 138-kV Transmission Line, Part 2, Project. Navy easements are required by HECO for an integral part of the 7.8-mile Waiau-CIP 138-kV Transmission Line, Part 2, Project, across a Navy access road just north of the H-1 freeway in the vicinity of Waikale Gulch, on the Pearl City Peninsula adjacent to the existing bikepath and state energy corridor, and near the Waiau Power Plant seaward of the H-1 freeway.

The proposed granting of easements by the Navy to HECO is not anticipated to have any adverse environmental effects which cannot be avoided or resolved through mitigation. Short-term impacts to the bike path can be mitigated by maintaining paved areas for bicyclists to use during installation of the poles and conductors. Traffic impacts during construction will be coordinated with the State Department of Transportation and the County Department of Transportation Services.

Visual clutter will be mitigated through the under-building of lower voltage transmission lines on the 138-kV poles. No flora or fauna species within the easement areas are listed as, or candidates for, endangered or threatened status. During prior consultations with the Department of Land and Natural Resources concerning the proposed Waiau-CIP, Part 2 transmission line, the State Historic Preservation Office concurred that overhead lines are likely to have "no effect" upon historic sites, including human burials. Should any unexpected archaeological deposits be discovered during excavations, work will stop and the State Historic Preservation Office will be consulted.

The Part 2 project has received major state and county approvals as follows:

1. The Hawaii Public Utilities Commission approved HECO's request to construct the project in Decision and Order No. 13201 issued 7 April 1994.
2. A Special Management Area Use Permit was granted for the project by the City & County of Honolulu by Resolution No. 92-307 adopted by the City Council on 17 February 1993.
3. The project's Final Environmental Impact Statement (EIS), prepared pursuant to the state's EIS rules, was accepted by the State Department of Transportation on 26 August 1992.

The Office of State Planning (OSP) reviewed the state EIS and submitted a comment letter, which is enclosed for your reference. The proposed overhead transmission line project is being designed by HECO to avoid impacts to

ENCLOSURE(1)

5090(P)
Ser 232/

wetland areas, as described in the enclosed EIS response to OSP's letter and as described in the enclosed materials.

Based on the information provided by HECO, the Navy has found the granting of easements to HECO for the Part 2 Project to be consistent with the Hawaii Coastal Zone Management (CZM) Program.

Enclosed for your review and concurrence on the Navy's consistency determination are a Hawaii CZM Program Assessment Form, a Federal Consistency Supplemental Information Form and a revised draft of the Navy's environmental assessment. This document specifically addresses the impacts of the proposed Navy actions.

If you have any questions, please call Mr. Stanley Uehara (Code 232), Navy Environmental Planner, at 471-9338 or by facsimile transmission at 474-4890.

Sincerely,

RALPH T. KANESHIRO
Director
Environmental Planning Division
Acting

Encl:

- (1) Office of State Planning
ltr Ref. No. P-3108
of May 22, 1992
- (2) Hawaiian Electric Company,
Inc. ltr of August 4, 1992
- (3) Hawaii CZM Program
Assessment Form
- (4) Revised Draft Environmental
Assessment for the Granting
of U.S. Navy Easements Near
Pearl Harbor and Waikele Gulch,
Oahu, Hawaii of May 6, 1994

**HAWAII CZM PROGRAM
ASSESSMENT FORM**

RECREATIONAL RESOURCES

Objective: Provide coastal recreational activities accessible to the public.

Policies:

- (1) Improve coordination and funding of coastal recreation planning and management.
- (2) Provide adequate, accessible, and diverse recreational opportunities in the coastal management area by:
 - (a) Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;
 - (b) Requiring replacement of coastal resources having significant recreational value, including, but not limited to surfing sites and sandy beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the State for recreation when replacement is not feasible or desirable;
 - (c) Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;
 - (e) Encouraging expanded public recreational use of County, State, and Federally owned or controlled shoreline lands having recreational value;
 - (f) Adopting water quality standards and regulating point and non-point sources of pollution to protect and where feasible, restore the recreational value of coastal waters;
 - (g) Developing new shoreline recreational opportunities, where appropriate, such as artificial reefs for surfing and fishing; and,
 - (h) Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the State Land Use Commission, Board of Land and Natural Resources, County planning commissions; and crediting such dedication against the requirements of section 46-6.

Check either "Yes" or "No" for each of the following questions.

YES NO

- | | |
|--|---|
| (1) Will the proposed action involve or be near a dedicated public right-of-way? | X |
| (2) Does the project site abut the shoreline? | X |
| (3) Is the project near a State or County park? | X |
| (4) Is the project site near a perennial stream? | X |
| (5) Will the proposed action occur in or affect a surf site? | X |
| (6) Will the proposed project occur in or affect a popular fishing area? | X |
| (7) Will the proposed action occur in or affect a recreational boating area? | X |
| (8) Is the project site near a sandy beach? | X |
| (9) Are there swimming or other recreational uses in the area? | X |

Discussion: The proposed easements are adjacent or near to the H-1 Freeway. The proposed easements located on the Pearl City Peninsula and near the Waiau Power Plant are adjacent to easements granted by the Navy for transportation purposes. Such areas are currently used for a paved bike/jogging path. The proposed transmission line poles will be adjacent to the path. Conductors will occupy the airspace over the path. The Pearl City easement area is east of Lehua Elementary School and Pearl City Kai Playground. The lines will not impact these recreational areas. One circuit will pass over Waimano Stream Flood Control Channel west of the Waiau Power Plant. Two circuits will pass over Waikeli Gulch adjacent to H-1. Locations of the school, park, streams and proposed transmission lines are shown in the Environmental Assessment.

HISTORIC RESOURCES

Objective: Protect, preserve, and where desirable, restore those natural and man-made historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and cultural.

Policies:

- (1) Identify and analyze significant archaeological resources;
- (2) Maximize information retention through preservation of remains and artifacts or salvage operations; and,
- (3) Support state goals for protection, restoration, interpretation, and display of historic resources.

Check either "Yes" or "No" for each of the following questions.

	<u>YES</u>	<u>NO</u>
(1) Is the project within a historic/cultural district?		X
(2) Is the project site listed or nominated to the Hawaii or National Register of Historic Places?		X
(3) Does the project site include undeveloped land which has not been surveyed by an archaeologist?		X
(4) Has a site survey revealed any information on historic or archaeological resources?		X
(5) Is the project site within or near a Hawaiian fishpond or historic settlement area?		X

Discussion: The cultural resources potential of the proposed action was surveyed as a part of the larger Waiau-CIP, Part 2, Project for inclusion in the August 1992 State Final EIS. The easements near Waiau Power Plant are on land adjacent to the boundary of the Pearl Harbor National Register Historic District and National Historic Landmark. This section of easements is also on unsurveyed land, although the land has been previously disturbed by road and building construction. Correspondence from the Department of Land and Natural Resources in connection with the Waiau-CIP, Part 2 EIS (included in the Environmental Assessment) indicates that the construction of overhead transmission lines will not have an "adverse effect" upon cultural or historical resources. A monitoring archaeologist will be present during excavation work.

SCENIC AND OPEN SPACE RESOURCES

Objective: Protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources.

Policies:

- (1) Identify valued scenic resources in the coastal zone management area;
- (2) Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of the natural landforms and existing public views to and along the shoreline;
- (3) Preserve, maintain and, where desirable, improve and restore shoreline open space and scenic resources; and,
- (4) Encourage those developments which are not coastal dependent to locate in inland areas.

Check either "Yes" or "No" for each of the following questions.

	<u>YES</u>	<u>NO</u>
(1) Does the project site abut a scenic landmark?		X
(2) Does the proposed action involve the construction of a multi-story structure or structures?	X	
(3) Is the project adjacent to undeveloped parcels?	X	
(4) Does the proposed action involve construction of structures visible between the nearest coastal roadway and the shoreline?	X	
(5) Will the proposed action involve construction in or on waters seaward of the shoreline?		X

Discussion: Visual resources are discussed in Chapters 4 and 5 of the environmental assessment. The proposed action will allow construction of transmission poles between 80 and 135 feet high. The areas proposed for easements do not abut scenic viewpoints or scenic landmarks. To reduce visual clutter of transmission lines and poles, where possible, existing lower voltage transmission lines that occupy the same alignment will be underbuilt on the same pole. With this arrangement, fewer poles will be needed for the same distance and typical spans will be between 350 and 800 feet. Views makai toward Pearl Harbor from the H-1 Freeway generally would not be interrupted because viewers would look between the widely spaced poles to the shoreline.

Undeveloped agriculture parcels are adjacent to the easements in the Pearl City area and in the Waikiki Gulch area. The transmission lines will not impact these parcels. Land use maps are shown in the Environmental Assessment.

ECONOMIC USES

Objective: Provide public or private facilities and improvements important to the state's economy in suitable locations.

Policies:

- (1) Concentrate in appropriate areas the location of coastal dependent development necessary to the State's economy;
- (2) Ensure that coastal dependent development such as harbors and ports, visitor industry facilities, and energy generating facilities are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and,
- (3) Direct the location and expansion of coastal dependent development to areas presently designated and used for such development and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:
 - (a) Utilization of presently designated facilities is not feasible;
 - (b) Adverse environmental effects are minimized; and,
 - (c) Important to the State's economy.

Check either "Yes" or "No" for each of the following questions.

	<u>YES</u>	<u>NO</u>
(1) Does the project involve a harbor or port?		X
(2) Is the project site within a designated tourist destination area?		X
(3) Does the project site include lands used/designated for agriculture?	X	
(4) Does the proposed activity relate to commercial fishing or seafood production?		X
(5) Does the proposed activity relate to energy production?		X
(6) Does the proposed activity related to seabed mining?		X

Discussion: Portions of the easement area within the Pearl City area near the Waiau Power Plant are zoned for agricultural use. Granting of the easements for the construction of transmission lines will not adversely impact the agricultural potential of the land. Although the proposed action is not an energy producer, Navy easements will allow for the construction of transmission lines which will link new independent power producers in Campbell Industrial Park with the main HECO transmission network. Also, the separate transmission corridor will provide more reliable power, thus permitting reasonable long-term growth.

COASTAL ECOSYSTEMS

Objective: Protect valuable coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosystems.

Policies:

- (1) Improve the technical basis for natural resource management;
- (2) Preserve valuable coastal ecosystems of significant biological or economic importance;
- (3) Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing needs; and,
- (4) Promote water quantity and quality planning and management practices which reflect the tolerance of fresh water and marine ecosystems and prohibit land and water uses which violate State water quality standards.

Check either "Yes" or "No" for each of the following questions.

	<u>YES</u>	<u>NO</u>
(1) Does the proposed action involve dredge or fill activities?		X
(2) Is the project site within the Shoreline Setback Area?		X
(3) Will the proposed action require some form of effluent discharge into a body of water?		X
(4) Will the proposed project require earthwork beyond clearing and grubbing?	X	
(5) Will the proposed action include the construction of special waste treatment facilities, such as injection wells, discharge pipes, or cesspools?		X
(6) Is an intermittent or perennial stream located on or near the project site?	X	
(7) Does the project site provide habitat for endangered species of plants, birds, or mammals?		X
(8) Is any such habitat located nearby?	X	
(9) Is there a wetland on the project site?	X	
(10) Is the project situated on or abutting a Natural Area Reserve?		X
(11) Is the project site on or abutting a Marine Life Conservation District?		X
(12) Is the project situated on or abutting an estuary?	X	

Discussion: Construction which would result from the granting of easements will include small scale excavation for the placement of poles. Transmission lines within the easements will cross Waimano Stream. All poles will be placed outside the stream channels and no alteration will be made to the channels. Wetlands are located near the Waiau Power Plant. However, construction within the easement areas will avoid wetland areas. Existing 46 kV lines within the wetland areas will be relocated to the 138 kV steel poles and the temporary wooden poles removed. The project will not adversely impact endangered species.

COASTAL HAZARDS

Objective: Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, and subsidence.

Policies:

- (1) Develop and communicate adequate information on storm wave, tsunami, flood, erosion, and subsidence hazard;
- (2) Control development in areas subject to storm wave, tsunami, erosion, and subsidence hazard;
- (3) Ensure that developments comply with the requirements of the Federal Flood Insurance Program; and,
- (4) Prevent coastal flooding from inland projects.

Check either "Yes" or "No" for each of the following questions.

	<u>YES</u>	<u>NO</u>
(1) Is the project on or abutting a sandy beach?		X
(2) Is the project within a potential tsunami inundation area as depicted on the National Flood Insurance Program flood hazard map?		X
(3) Is the project within a potential flood inundation area according to a flood hazard map?		X
(4) Is the project within a potential subsidence hazard area according to a subsidence hazard map?		X
(5) Has the project site or nearby shoreline areas experienced shoreline erosion?		X

Discussion: The proposed action will not affect or be affected by coastal hazards. Poles installed will be designed to withstand hurricane force winds. Areas are out of the 100-year flood and tsunami inundation zones.

MANAGING DEVELOPMENT

Objective: Improve the development and review process, communication, and public participation in the management of coastal resources and hazards.

Policies:

- (1) Effectively utilize and implement existing law to the maximum extent possible in managing present and future coastal zone development;
- (2) Facilitate timely processing of applications for permits and resolve conflicting permit requirements; and,
- (3) Communicate the short- and long-term impacts of proposed significant coastal developments early in their life cycle in terms understandable to the general public to facilitate public participation in the planning and review process.

Check either "Yes" or "No" for each of the following questions.

	YES	NO
(1) Will the proposed activity require more than two (2) permits or approvals?		X
(2) Does the proposed activity conform with the State and County land use designations for the site?		X
(3) Has or will the public be notified of the proposed activity?		X
(4) Has a draft or final environmental impact statement or an environmental assessment been prepared?		X

Discussion: The proposed activity of granting easements to HECO will not require additional permits or approvals. However, the installation of a 138 kV transmission line which will result from the granting of easements does require additional permits and approvals from State and County governments. On 17 February 1993, a Shoreline Management Permit was granted by the City Council of the City & County of Honolulu. Additional permits needed for construction include: Army Corps of Engineers Utility Crossing Permit, Hawaii DOT permits to Work in State Highways, and City & County of Honolulu Street Usage Permit. The transmission lines are permitted uses under all State and County land designations within the easement areas. A State Final EIS was prepared for the entire Waiau-CIP, Part 2, Project and was accepted by the Department of Transportation on 26 August 1992. An extensive public consultation process was followed for the preparation of that document. A Draft Environmental Assessment has been prepared for the granting of the Navy easements. The public will be notified prior to the implementation of the proposed activity. Approval for the Part 2, Project was granted by the Public Utilities Commission in April 1994.

FEDERAL CONSISTENCY
SUPPLEMENTAL INFORMATION FORM

Date: _____

Project/Activity Title or Description:

Location: Island: Oahu **District:** Pearl Harbor
Tax Map Key No.: Portions of: 9-4-02:12; 9-7-18:03; 9-7-18:10; 9-7-18:20; 9-8-3:33; and
9-8-4:16

Other applicable area(s), if appropriate:

Estimated Start Date: August 1994 **Estimated Duration:** 12 months
APPLICANT

Name and Title: Melvin Kaku, Code 23

Agency/Organization: U.S. Navy, Pacific Division, Naval Facilities Engineering Command

Address: Pearl Harbor, Hawaii 96860-7300

Telephone No. During Business hours: (808) 471-9338

AGENT

Name and Title: Paul Luersen, AICP

Agency/Organization: CH2M HILL, Inc

Address: 1585 Kapiolani Boulevard, Suite 1420, Honolulu, HI 96814

Telephone No. During Business hours: (808) 943-1133

CATEGORY OF APPLICATION (CHECK ONLY ONE)

- [X] I. Federal Activity [] III. OCS Plan Permit
[] II. Permit or License [] IV. Grants & Assistance

TYPE OF STATEMENT (CHECK ONLY ONE)

- [X] Consistency
[] General Consistency (Category I only)
[] Negative Determination (Category I only)
[] Non-Consistency (Category I only)

APPROVING FEDERAL AGENCY (Categories II, III, and IV only)

Agency:

Contact Person:

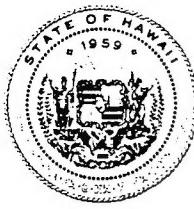
Telephone Number during business hours:

FEDERAL AUTHORITY FOR ACTIVITY

Title of Law: National Coastal Zone Management Act of 1972, 15 CFR Part 930

OTHER STATE AND COUNTY APPROVALS REQUIRED

<u>Agency</u>	<u>Type of Approval</u>	<u>Date of Application</u>	<u>Status</u>
---------------	-------------------------	----------------------------	---------------



OFFICE OF STATE PLANNING

Office of the Governor

MAILING ADDRESS: P.O. BOX 3540, HONOLULU, HAWAII 96811-3540
STREET ADDRESS: 250 SOUTH HOTEL STREET, 4TH FLOOR
TELEPHONE: (808)587-2846, 587-2800

JOHN WAIHEE Governor

FAX: Director's Office 587-2848
Planning Division 587-2824

Ref. No. C-838

September 14, 1994

Mr. Ralph Kaneshiro
Acting Director
Environmental Planning Division
Department of the Navy
Pacific Division
Naval Facilities Engineering Command
Pearl Harbor, Hawaii 96860-7300

Dear Mr. Kaneshiro:

Subject: Hawaii Coastal Zone Management (CZM) Program Federal Consistency for Granting Easements for the Waiau-Campbell Industrial Park 138-kV Transmission Line, Part 2

Your proposal to grant three Navy easements to Hawaiian Electric Company, Inc. (HECO) for portions of the Waiau-Campbell Industrial Park 138-kV Transmission Line, Part 2, has been reviewed for consistency with Hawaii's CZM Program. We concur with your CZM assessment and finding that the activity is consistent with the following conditions required to mitigate potential CZM impacts.

1. An archaeologist shall be present during all excavation work to monitor for archaeological resources as proposed in the CZM assessment on page 3.
2. Continuous public use of the bike path shall be maintained during installation of the poles and conductors as proposed on pages 1-3 and 5-2 of the environmental assessment dated May 6, 1994.

Mr. Ralph Kaneshiro
Page 2
September 14, 1994

CZM consistency approval is not an endorsement of the project nor does it convey approval with any other regulations administered by any State or County agencies. Thank you for your cooperation in complying with Hawaii's CZM Program. If you have any questions, please call our CZM office at 587-2878.

Sincerely,

marylou kobayashi for
Norma Wong
Director

cc: Mark Willey, CH2M HILL ✓
Department of Land & Natural Resources,
OCEA and Historic Preservation
Department of Transportation
Department of Land Utilization, City & County of Honolulu